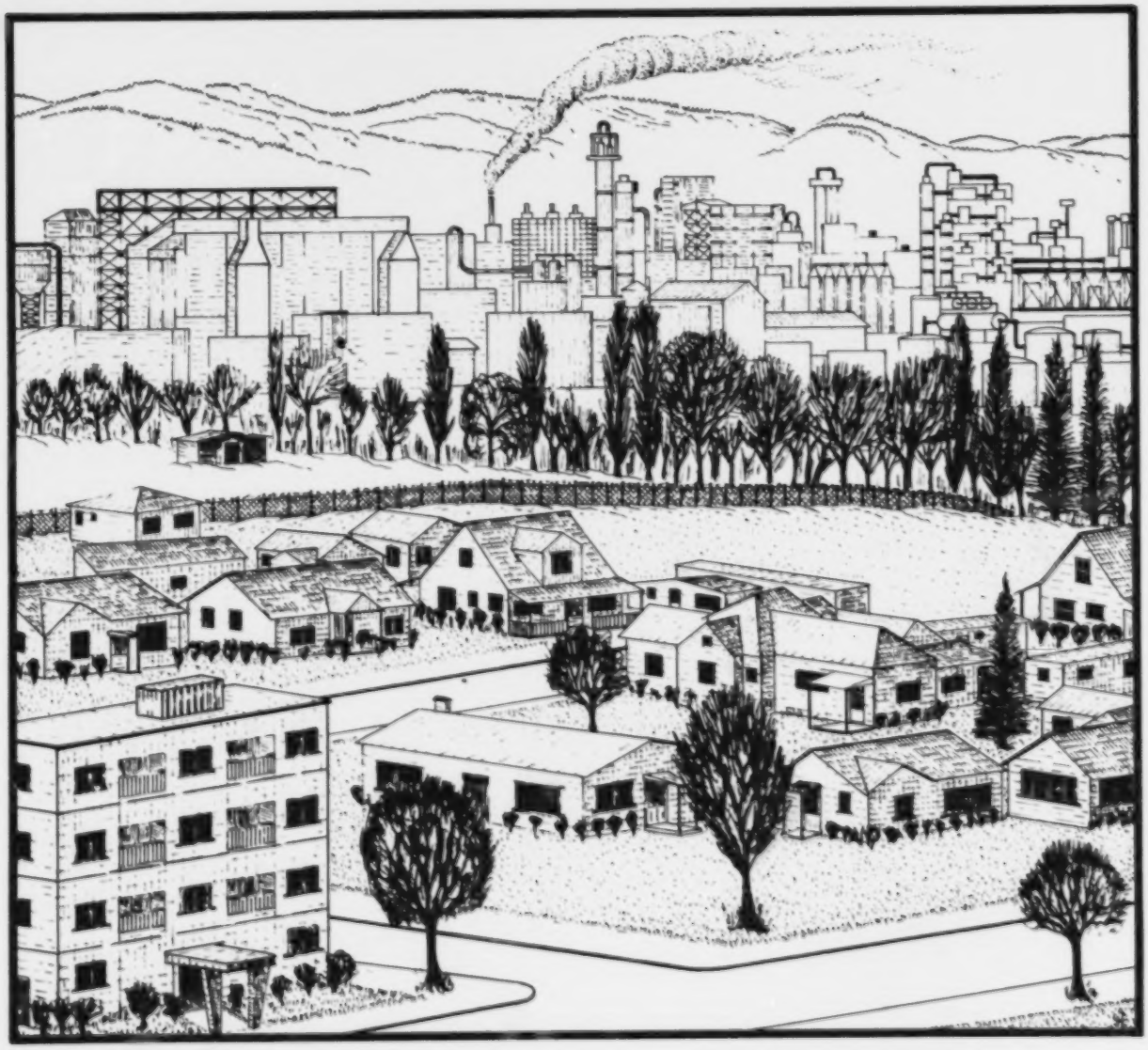
Bhopal Aftermath Review : An Assessment of the Canadian Situation

March 1986



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BHOPAL AFTERMATH REVIEW: ASSESSMENT OF THE CANADIAN SITUATION

prepared by a Steering Committee and three Working Groups representing:

Agriculture Canada
Alberta Energy Resources Conservation Board
Canadian Association of Administrators of Labour Legislation
Canadian Chemical Producers' Association
Canadian Fertilizer Institute
Canadian Petroleum Association
Canadian Transport Commission
Emergency Planning Canada
Environment Canada
Health and Welfare Canada
Petroleum Association for the Conservation of the Canadian Environment
Regional Industrial Expansion
Transport Canada

March 1986

NOTICE

The contents of the report are the opinions of the members of the Steering Committee and the three Working Groups and may not necessarily reflect the views of their respective agencies, companies or organizations.

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Environment Canada Environnement Canada

Ottawa, Ontario
K1A 1C8

The Honourable Tom McMillan
Minister of the Environment

Dear Sir

In December 1984, in light of the tragic industrial accident in Bhopal, India, the then Minister of the Environment instructed the Department to undertake an assessment of the adequacy of existing measures to prevent and respond to major industrial accidents in Canada.

I am pleased to submit this report on behalf of the members of the Bhopal Aftermath Review Steering Committee and working groups. This work represents the cooperative effort of many industrial associations and government agencies.

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Chairman

March, 1986

Canada

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CONTENTS

		Page
FOREWORD		xi
ACKNOWLEDGEMENT		xiii
OVERVIEW: WHAT CAN WE LEARN FROM BHOPAL?		1
CONCLUSIONS AND RECOMMENDATIONS		5
PART I - POTENTIAL		27
SUMMARY		29
1	INTRODUCTION	31
2	BACKGROUND ON MAJOR INDUSTRIAL SECTORS	33
2.1	Oil and Gas Production Sector	33
2.2	Petroleum Refining Sector	34
2.3	Chemical Industry Sector	35
3	ASSESSMENT OF RISK	37
3.1	Prospective Approach	37
3.1.1	Hazard Criteria	37
3.1.2	Probability	39
3.2	Retrospective Approach	41
4	SPECIAL CHEMICALS AND CONSIDERATIONS	45
REFERENCES		47
BIBLIOGRAPHY		47
APPENDIX I-1	TRANSPORTATION OF DANGEROUS GOODS ACT HAZARDOUS CHEMICALS WITH DISPERSIVE AND EXPLOSIVE POTENTIAL	51
APPENDIX I-2	NATES - 150 MOST FREQUENTLY SPILLED SUBSTANCES	65
APPENDIX I-3	CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON HISTORICAL SPILL DATA	69
APPENDIX I-4	SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS	73

		Page
PART II - PREVENTION		79
SUMMARY		83
1	INTRODUCTION	85
2	LEGISLATION FOR ACCIDENT PREVENTION	86
2.1	Municipal	86
2.2	Provincial	87
2.3	Federal	90
3	MANAGEMENT OF SAFETY AND LOSS PREVENTION	94
3.1	Corporate Commitment	94
3.2	Responsible Care Programs	95
3.3	Training	95
3.4	Auditing	97
4	ACCIDENT PREVENTION MEASURES	99
4.1	Industry	99
4.1.1	Engineering Design and Construction	99
4.1.2	Operations	99
4.1.3	Storage and Distribution	102
4.1.4	Effectiveness of Industry Practices	102
4.2	Government	104
4.2.1	Workplace Hazardous Materials Information System (WHMIS)	104
4.2.2	Transportation and Routing	104
4.3	Information Programs	105
4.3.1	Safety Associations	105
4.3.2	Canada Centre for Occupational Health and Safety (CCOHS)	105
4.3.3	Other Sources	107
5	REACTION TO BHOPAL-TYPE INCIDENTS	109
5.1	Chemical Industry	109
5.2	Petroleum Refining Industry	110
5.3	Oil and Gas Production Sector	111
5.4	Other Industry Sectors	112
6	WORKER AND COMMUNITY AWARENESS	113
REFERENCES		115
BIBLIOGRAPHY		116

		Page
APPENDIX II-1	LIST OF OCCUPATIONAL HEALTH, SAFETY AND RELATED ENVIRONMENTAL LEGISLATION	121
APPENDIX II-2	PERSONNEL SAFETY TRAINING CRITERIA	125
APPENDIX II-3	CANADIAN CHEMICAL PRODUCERS' ASSOCIATION SAFETY ASSESSMENT SYSTEM	131
APPENDIX II-4	INTERNATIONAL SAFETY RATING SYSTEM - FIVE STAR PROGRAM	139
APPENDIX II-5	EXAMPLES OF INDUSTRY ACCIDENT PREVENTION MEASURES DURING ENGINEERING DESIGN AND CONSTRUCTION	143
PART III - RESPONSE		**149**
SUMMARY		151
1	INTRODUCTION	153
2	EMERGENCY INCIDENTS READINESS AND RESPONSE	155
2.1	Industries	155
2.1.1	The Petroleum Industry	155
2.1.2	The Industrial Chemical Industry	157
2.1.3	Other Segments of the Chemical Industry	161
	The Chlorine Industry	161
	The Specialty Chemicals Industry	161
	The Pesticide Industry	161
	The Fertilizer Industry	162
2.1.4	Other Process Industries	162
	The Pulp and Paper Industry	162
	The Mining Industry	163
	The Manufacturing Industry	163
2.1.5	The Transportation Industries	163
	The Railway Industry	163
	The Trucking Industry	164
	The Marine/Shipping Industry	165
	The Air Transport Industry	166
2.2	Governments	166
2.2.1	General Emergency Preparedness	166
2.2.2	Government Systems for Emergencies	168
	Municipal	168
	Provincial/Territorial	169
	Federal	170
	International/Bilateral	171

		Page
3	OTHER DISCUSSION TOPICS	173
3.1	"Good Samaritan" Protection	173
3.2	Community Awareness and Contingency Planning	174
3.3	Emergency Medical Services	176
3.4	On-Scene Coordination of Response	178
3.5	Spill Response Training	180
3.6	Technical Information Needs	185
3.7	Spill Technology Research and Development	185
3.8	Post-Event Information Exchange	187
APPENDIX III-1	LOCATIONS OF TEAP REGIONAL RESPONSE CENTRES	193
APPENDIX III-2	TEAP/CCPA - RECOMMENDED EQUIPMENT LIST	197
APPENDIX III-3	THE CCPA "DISCIPLINED APPROACH"	203
APPENDIX III-4	EMERGENCY SYSTEMS IN CANADA	207
APPENDIX III-5	PREPAREDNESS QUESTIONNAIRE	211
APPENDIX III-6	EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS	233

FOREWORD

On December 3, 1984, the world's most tragic chemical accident occurred at Bhopal, India. Over 2000 people were killed and tens of thousands were injured. In the few days that followed the Bhopal release, Canada's Minister of the Environment announced that departmental officials would be contacting their federal and provincial colleagues and representatives of industry to assess the adequacy of existing accident prevention and emergency preparedness measures.

Five years before Bhopal, in November 1979, the City of Mississauga faced a major chemical transportation accident of potentially catastrophic proportion. Over 200 000 residents were evacuated without incident. That experience brought many changes in the way dangerous commodities are shipped by rail in this country and spurred on safety efforts in other methods of transport, leading to the Transportation of Dangerous Goods Act in 1980 and subsequent regulations in 1985.

The sour gas well blowout at Lodgepole, Alberta, in October 1982, had a similar effect. The oil and gas production sector strengthened its measures to prevent accidents, especially during drilling, and took steps to drastically reduce the impact should an accident occur.

The Bhopal accident triggered the chemical industry to increase its efforts in the areas of plant safety, community awareness and emergency response.

An industry/government steering committee met in March, 1985, to establish terms of reference for the Bhopal Aftermath Review Project. Working groups were formed to:

- examine the **potential** for Bhopal-type incidents in Canada;
- review measures taken by industry and governments to **prevent** accidents;
- assess the collective ability of industry/government to **respond.**

In July 1985, a discussion paper outlining the issue and the Steering Committee's need for more information on industry and agency programs, legislative aspects and public concerns was distributed to over 300 recipients. Several organizations and associations, including representatives of environmentalist groups, labour agencies, and municipalities, indicated their desire to participate in the project. Over 700 copies of the working group draft reports were distributed and in early December, a series of six meetings were held across the country where interested parties could consult with and provide comment to Steering Committee members. The results of this extensive

consultation have greatly benefitted the committee's work and have resulted in the final report.

In the early part of its work, the Steering Committee had to determine the scope of its work. It was decided that an intensive investigation of the Bhopal incident would not significantly advance the cause of accident prevention in Canada. What was needed was an overall picture of where we stand in Canada today, on major accident prevention and emergency preparedness. As Canada has not had an accident with such a tragic result, **we defined a Bhopal-type incident as a major industrial or transportation incident resulting in an acute exposure to a chemical that has the potential to cause death or adverse health effects in the community.** Accidents such as the Mississauga train derailment, the Lodgepole blowout and many others, illustrate the type of incident on which we wanted to focus. Throughout the text we have used Bhopal-type incident and other terms, such as major industrial accident, interchangeably.

This report provides an overview of the lessons we can learn from Bhopal, conclusions and recommendations and the reports of the three working groups.

Future action will involve industry, governments at all levels and citizens who, while becoming more cognizant of the dangers around them, must become more responsive and participative. The recommendations will have to be evaluated by:

- government agencies (at all levels) that have a legislated mandate to act in a particular area, such as zoning, plan approval, worker safety, transport, public and environmental protection;
- industry, which has the ultimate managerial responsibility for loss prevention; and
- interested parties, such as labour and the public, which have the right to work in and live in a safe environment.

The Steering Committee recognized that this review can only point the way to reducing the risk to society of major industrial accidents such as Bhopal. We also recognize that Canadians enjoy a lifestyle that relies on potentially dangerous chemicals. Ensuring that chemicals are managed better and that Canadians are adequately protected depends on the personal commitment of politicians, industrialists, workers, public officials and the general public. If we, collectively are not prepared to make this commitment then we may face the consequences of a Canadian Bhopal.

ACKNOWLEDGEMENT

The contents of this report represent the views of a wide cross-section of technical expertise in government and industry. These experts have scientific backgrounds in such areas as chemical engineering, toxicology, public administration, chemistry, emergency planning, industrial health and hygiene, plant management and emergency response. All of the advice received cannot be documented but the Steering Committee and Working Group members recognize the guidance we have received from colleagues in their particular fields and we have certainly considered that advice in arriving at conclusions and in formulating recommendations.

The contributions of all those in industry, government agencies and specific organizations who took the time to provide information to us is appreciated. We believe that this report reflects a broad concensus for action to improve already strong systems for accident prevention and emergency preparedness.

As this assessment was conducted at the request of the Minister of Environment, most of the coordination and support has been provided by staff in Environment Canada. The Steering Committee and Working Groups acknowledge the help provided by Raouf Morcos who acted as our general secretary and assistant in organizing our activities and preparing and circulating information on our project. This help directly extended to Marielle Groulx who provided secretarial support. Regional Environmental Protection Service staff assisted in coordinating contacts with local officials and in setting up public consultation meetings.

The actual production of the report is the credit of Vicky Jones, our publications manager, with the assistance of Michèle Letienne-Prévost, both of whom met some rather unrealistic deadlines in a truly professional manner. Word processing was provided by the EPS Word Processing Centre.

And finally, we want to thank Mr. Peter Budzik for his dedication to the goals of the project, his strong technical guidance and his thoughtful advice and interpersonal skills in bringing all members of the Steering Committee and Working Groups together.

This "Assessment of the Canadian Situation" in relation to major industrial accidents is only one step in a continuing process of improved prevention and preparation for chemical-related emergencies. The spirit of cooperation which has been demonstrated in identifying areas for further improvements must continue to ensure the implementation of the recommendations.

OVERVIEW: WHAT CAN WE LEARN FROM BHOPAL?

One of the obvious lessons that Canadians have learned from Bhopal is that large scale human suffering and death can result from major chemical accidents. We have again been reminded that a population that benefits from the advances made by technology also bears a risk for adverse effects which can never be entirely eliminated. We see once more the message that such accidents, as well as smaller incidents and near-misses must be studied in depth for the many lessons they can provide to prevent and mitigate future disasters. Identifying the lessons in hindsight and documenting them is the easier, but less important task. People within an organization must be committed to the frequent review and application of such lessons for their own situations. As a loss prevention expert once said, "Organizations have no memories". Foresight and preventive action before the next event is the more important and difficult task.

In the Canadian context, we have experienced a number of serious chemical accidents in recent years, although fortunately with little loss of life. Many people recall names like Mississauga and Lodgepole in this context, but there have been a number of other accidents and near-misses. As a nation, we have learned some lessons and made some improvements, but Bhopal has shocked the whole system, and made all parties more receptive to review and change for improved industrial safety and loss prevention. The greatest challenge is to sustain this awareness and continuing concern in the months and years ahead.

As a first step in meeting this challenge we must address a number of specific lessons or issues which the Bhopal disaster has raised:

(i) Potential for Chemical Accidents

The Bhopal disaster provided direction for the committee to shape the criteria for identifying chemicals that have a potential for a major chemical incident. By reviewing all possible mechanisms by which the public could be exposed to catastrophic events caused by chemical accidents, it was possible to define the characteristic by which chemicals with such potential could be identified.

Although the chemicals involved in the Bhopal incident are not manufactured in Canada, other chemical agents equally dangerous are made and used in this country. The committee concluded that, while the safeguards in place go a long way to minimize the occurrence of such a major incident, Canadians should not become complacent as the possibility for such an incident is always present.

(ii) **Siting and Land-Use Control**

In Bhopal, residences were built virtually up to the factory gate and so any major release would affect the community. To a certain extent in Canada, residential development has been allowed in close proximity to industrial plants even though most municipalities have zoning by-laws. We must find ways to ensure that this does not occur for new facilities and look at ways to maintain buffer zones at existing plants. Politicians and officials who make zoning or planning decisions of this type must be fully aware of the potential hazards which may be involved in plant siting.

(iii) **Safety Management Systems**

When we reflect on the Bhopal lessons for Canada, a number of conclusions can be drawn regarding safety management. As an example, many improvements have been made in the field of hazard analysis and risk management in recent years and these developments will continue. Certainly, the plant at Bhopal would have been designed using some of these techniques. But even though the plant was relatively new, evidence suggests that changes were made in processes, equipment, maintenance and operations which were not taken into account through proper hazard analysis. While this kind of incident could occur in a large plant, it is more likely to happen in a smaller facility that does not have rigorous design analysis procedures and management safety systems.

The lesson here is that we need to ensure that all plants apply hazard analysis and risk management techniques in the assessment of their processes and operations. This assessment should be comprehensive and should re-examine even basic process design questions regarding toxic chemicals. Examples would include re-evaluation of the required inventory volumes and/or concentrations, and the possibilities of substitution of less toxic chemicals involved in the process.

Another lesson involves the need to consider <u>total</u> incident costs when examining risks, economics and the merits of process changes or operational improvements for safety and loss prevention. Management must provide adequate resources and corporate commitment to the loss prevention function. In addition to the human suffering involved, the magnitude of potential economic impact of a major chemical accident on even the largest of industrial companies was brought forcefully to the attention of every corporate executive by the aftermath of the Bhopal accident.

Increasingly, industries should be recognizing the benefits of auditing the safety of their hazardous material operations by competent independent experts. The Bhopal experience suggests that such reviews should be carried out periodically throughout the life of the plant or other hazardous operation. Companies should keep abreast of, and use as soon as feasible, the best of available and new safety technologies.

Another lesson involves the reminder that hazardous chemical plants cannot be allowed to operate unless all safety systems are adequate and are functioning properly. This increased awareness and commitment must somehow be sustained in future when recent accidents begin to fade from people's memories. In addition, all industrial workers, supervisors and managers involved in making, handling, storing, transporting or using hazardous chemicals must be sure they understand the nature of the hazards in their control, and the possible magnitude and implications of a major accident.

Every employee must be alert to such hazards, and be able to evaluate and communicate his concerns. Management must be listening and responding as needed to these concerns.

(iv) **Community Awareness**

It is difficult to say whether public knowledge of the chemicals involved in Bhopal would have assured any different outcome. Certainly, the government officials who approved the siting of the plant were aware of the chemicals. Many of the people who were killed lived in poverty and may have had little other choice except to live where they did, even if they understood the potential danger.

While we are fortunate in Canada not to have the problems that faced the people of Bhopal, we must never assume that the people living next to industrial plants are not concerned with what goes on behind the factory fence. The public may not be concerned with the technical details of a process (i.e., temperature, pressure or type of catalyst), but they do want, and have a right, to know whether chemicals are present that could harm them and what safeguards are in place.

Bhopal has triggered a reaction by industry that recognizes this right and industry is initiating programs to communicate more openly with the community. The Steering Committee believes that this is a two-way street and that if industry is willing to work with the community, community officials must respond in kind. This may take more resources in terms of staff to work jointly with industry to develop the appropriate contingency plans.

(v) **Emergency Preparedness and Response**

Any major disaster can strain or overwhelm the collective capability for response. Emergency planning, establishment of adequate warning and response systems and care of the affected population are three important facets of this capability. Most reports from Bhopal indicate an inadequate warning system was further hampered by a delay of several hours in sounding the alarm; and by a lack of training or knowledge on how to respond on the part of both employees and nearby residents. Clearly, a warning must be immediate, and the response based on a set of comprehensive and integrated contingency plans for both the facility and the nearby community. These plans must be publicized and tested on a regular basis. They should be sufficiently detailed to include such options as deliberate destruction of property (e.g., igniting the gas cloud at Bhopal) if safety concerns for a populated area become paramount.

(vi) **Emergency Medical Treatment**

There is general agreement that the medical staff in Bhopal did everything that they possibly could to treat the victims. However, there is also evidence that the necessary antidote information was not made available to the doctors until some 24 hours after the release. Some debate still exists about the nature of the exact poison mechanisms involved in this tragedy.

In Canada, we can and must take steps to ensure that the medical staff in our hospitals are knowledgeable in the methods required to treat victims of the most probable chemical releases in a specific area and that information is available at a moment's notice for other situations. However, along with the knowledge of medical protocols, the medical supplies for treatment must also be available on short notice. Identification or provision of inventories of such specialized material and equipment should be undertaken in higher risk areas for those chemicals of local concern.

CONCLUSIONS AND RECOMMENDATIONS

In assessing the adequacy of existing measures in Canada to prevent and respond to major industrial accidents such as occurred at Bhopal, the Bhopal Aftermath Review Working Groups and Steering Committee came to a number of conclusions that identify where further action is recommended to improve information transfer, strengthen operation of industries and government agencies, and provide more efficient and effective safety management and emergency preparedness systems. These recommendations will require commitments of resources, both human and financial, for their implementation.

Throughout the consultations across the country, the Steering Committee was reminded of the need for leadership and coordination in ensuring that recommended actions are taken. The Steering Committee suggests that a task force of senior level officials from appropriate departments (federal and provincial), representatives of industry and possibly other parties representing the community interest be established to evaluate the implications of the recommendations on the resources of various government agencies and industry. This task force could also coordinate or at least monitor specific activities that are undertaken and could report at a future date on the progress that has been achieved. The Steering Committee believes that existing federal/provincial committee structures with their expertise in specific areas could offer appropriate assistance to the task force in reviewing and implementing the recommendations.

Each recommendation is followed by a listing of those organizations or groups which the Steering Committee feels could be involved in follow-up action. The organizations and groups are designated as follows:

E	Environment	T	Transport
H	Health and Welfare	P	Emergency Planning
L	Labour (includes all aspects of occupational safety and health)		

Risk Assessment

Conclusion 1. In Canada we manufacture, use and transport many chemicals that fit the hazard criteria for chemicals that could give rise to a major industrial accident. The analysis of use patterns and spill trends of chemicals used in Canada indicates that there is a definite correlation between the chemicals most commonly used in industry and those spilled in greatest volume and frequency.

It is possible to apply criteria based on toxicity, flammability and dispersive and explosive characteristics as has been done in the Transport of Dangerous Goods Regulations to determine which chemicals have the greatest potential to affect a large population in the event of a major spill or release.

Recognizing that it is not feasible to anticipate all possible accidents, criteria were developed to identify chemicals having a potential for large scale incidents in Canada. In addition to these criteria, qualitative risk analyses can be carried out taking into account such factors as volume of material present, storage conditions, and other parameters, on a case-by-case basis.

Recommendation 1

(a) Using the hazard criteria as a basis for identifying the chemicals of importance, a site-specific risk assessment should be carried out for each industrial plant to determine the potential for a major industrial accident. (Industry)

(b) Industry should involve community officials in risk assessments. (Municipalities; Industry)

(c) Information contained in Material Safety Data Sheets should be provided by companies to emergency response teams through public officials as input to the risk analysis. (Industry; Municipalities)

(d) A central "clearing house" for the preparation of uniform Material Safety Data Sheets should be established. (Federal/Provincial)

Chemical Spill Response Information

Conclusion 2. Data bases providing profiles for all chemicals manufactured, used or transported in Canada already exist in various agencies such as Transport Canada, Environment Canada, the Canadian Centre for Occupational Health and Safety, chemical companies and others. Information can be obtained quickly by telephone through the Canadian Transportation Emergency Centre (CANUTEC), Environment Canada, or from the manufacturer.

Emergency responders also require readily-available reference materials in the form of handbooks or manuals which can be used at the accident scene. Government publications presently do not contain all necessary information on chemicals that meet the hazard criteria for Bhopal-type incidents.

An important consideration in many emergency situations is the mixture of chemicals. In these cases, the first responder must seek the advice of experts as the combination of chemicals that could occur cannot possibly be covered in an easy-to-use manual.

Recommendation 2

(a) Transport Canada's initial response book "Emergency Response Guide for Dangerous Goods" should be reviewed and Environment Canada's second level response manual "Manual for Spills of Hazardous Materials" should be updated and expanded to include on a priority basis Bhopal-type chemicals listed in Schedule XII, Part II of the Transport of Dangerous Goods Regulations. (Federal: E, T)

(b) Government agencies, industry, and representatives of first responders should determine how this information might best be disseminated to users. The policy of cost-recovery for such materials should be examined. (Federal: E, L, T; Provincial: E, L, T)

Safety Audits and Assessments

Conclusion 3. After the sour gas well accident at Lodgepole, Alberta, the oil and gas production sector re-examined its safety programs and implemented stronger measures in many areas. The petroleum refining industry, due mainly to the size of its operations and corporate structure, has had safety and loss prevention programs in place for some time. The majority of chemical companies also have safety audit programs, but immediately after Bhopal, the Canadian Chemical Producers' Association (CCPA) assessed the extent of audit practices within its membership. The CCPA then developed a standardized safety assessment procedure for use by its members in their plants.

Other safety audit programs, such as the Five Star Program administered by the Industrial Accident Prevention Association in Ontario, are also used in Canada at many plant sites.

Recommendation 3

(a) Industry through its associations and governments should determine the actual status of safety and accident prevention programs as well as auditing activities in medium and small operations. (Federal: E, L; Provincial: E, L; Industry)

(b) Major industrial associations should provide assistance to medium and small companies and share information relevant to establishing safety and accident prevention programs. (Industry)

(c) The standard safety assessment procedure developed by the Canadian Chemical Producers' Association or the Five Star Program should be implemented widely by all chemical user industries to establish and maintain adequate safety management systems. (Industry)

First Steps to Hazard Reduction

Conclusion 4. Although many companies have adopted extensive measures to reduce the risk associated with hazardous materials, certain immediate actions were identifed as a minimum first step.

Recommendation 4

Companies using or manufacturing hazardous chemicals should:

(a) minimize inventories of hazardous materials (Industry);

(b) exchange information on accidents and "near-misses" (Industry); and

(c) ensure that personnel are fully trained and knowledgeable about the hazardous chemicals they are required to handle (Industry).

Safety Statistics

Conclusion 5. The accident record of the Canadian chemical and petroleum industries is, in general, better than the average for other industry sectors. However, the information base that documents this record needs to be improved. Worker loss-time and illness statistics can be interpreted as an indication of the attitude and approach taken by an industry sector towards safety but not necessarily as a reflection of the programs in place to prevent a Bhopal-type incident.

Recommendation 5

Governments and industry should make safety statistics available to one central clearing house such as Statistics Canada or the Canadian Centre for Occupational Health and Safety. These statistics should specifically include data related to hazardous chemical accidents. (Federal: E, T, L, H; Provincial: E, T, L, H; Industry)

Contingency Planning

Conclusion 6. In the petroleum, industrial chemical and major railway industries, the development of chemical spill contingency plans has been underway for many years. These industries are continually reassessing and improving their capabilities for dealing with serious chemical accidents. Companies that transport or use Bhopal-type chemicals in their operations can learn from the experiences of the major producers or suppliers and transporters.

Recommendation 6

(a) Contingency plans and planning guidelines such as those developed by Canadian Petroleum Association and Alberta Public Safety Services for possible sour gas releases, as well as the emergency preparedness assessment program of Canadian Chemical Producers' Association, should be used as exemplary models by all companies involved with Bhopal-type chemicals to develop contingency plans.

(b) Companies that use chemicals of concern and their industry associations (e.g., the Canadian Pulp and Paper Association, the Mining Association of Canada, and the Canadian Manufacturers Association) should, in consultation with the appropriate agencies, review their emergency

preparedness programs to ensure a firm commitment to spill prevention, an initial response capability, and a rapid access to response teams. (Federal: E, L; Provincial: E, P, L; Industry; Municipalities)

(c) The Canadian Trucking Association, in cooperation with provincial emergency measures agencies and others that administer the on-highway transportation of dangerous goods, and in consultation with Transport Canada and the Canadian Chemical Producers' Association, should review existing training programs for truckers and handlers of Bhopal-type chemicals to ensure that adequate knowledge of initial-response actions for such chemicals is being provided. A followup to the review may involve specific projects for individual companies or for the association. (Industry; Provincial: T)

(d) The many small railways in Canada should consult with CN and CP, and with other government agencies to ensure an adequate capability for dealing with incidents involving Bhopal-type chemicals. The adequacy of their response capabilities, including countermeasures equipment available from mutual-aid sources, should be examined and additional capability should be acquired if necessary. (Federal: T (CTC))

(e) The Canadian Coast Guard (Ship Safety and Emergencies groups), in consultation with the industrial associations and appropriate government agencies, should review the spill prevention and response capability of the shipping industry. (Federal: E, T; Provincial: P, E, T; Industry)

Spill Reporting and Analysis

Conclusion 7. Reporting of spills as required by the Transportation of Dangerous Goods Regulations is providing an extensive data base on transportation related accidents. The National Analysis of Trends in Emergencies System (NATES) was designed to compile and analyze information on spills from all sources. However, the reporting of plant-site releases, is not consistent amongst provinces; the information is also voluntarily supplied to NATES by the provinces. As transportation sector reporting is mandatory and the other sectors are not, there are consequent gaps and inconsistencies of information in the data base.

Recommendation 7

As the data base for plant-site releases should parallel the activity for transportation incidents:

(a) Legislation requiring the reporting of spills/releases from non-transport accidents to a particular government agency on a mandatory basis should be examined. (Federal: E, T; Provincial: E, T)

(b) Government agencies should re-examine the NATES program and the level of resources necessary to maintain and improve the system. (Federal: E, T; Provincial: E, T)

Using Contaminant Levels for Planning Evacuations

Conclusion 8. In developing emergency response plans, the concentration levels of chemicals in the ambient air at which public evacuation or public protection measures should be initiated needs to be established. The oil and gas production sector has been able to arrive at ambient air concentration levels of hydrogen sulphide above which evacuation must take place. No similar levels have been identified for other hazardous chemicals.

Recommendation 8

(a) A government/industry/public sector study group should be formed to determine the concentrations of hazardous chemicals in the ambient air at which public protection procedures should be initiated. (Federal: P, H, E; Provincial: P, H, E; Municipalities; Industry)

(b) In the case of transportation accidents involving a spill, information should be available on-scene as to the hazards associated with the substance and the public protection measures that should be initiated. (Federal: T; Provincial: P, T; Industry)

"Lessons from Accidents"

Conclusion 9. There is a need for a greater and more accessible exchange of information on lessons learned for prevention and response purposes from previous accidents and near-misses. A Canadian forum for inter-company, inter-industry and inter-government sharing of such information is desirable. Greater Canadian participation in, and subscription to, existing information exchange schemes in the U.K. and/or the U.S.A. would also be beneficial.

Recommendation 9

Through their industry associations, the Canadian chemical and petroleum industries should jointly evaluate existing accident information exchange systems and, in consultation with federal and provincial government agencies, develop a co-operative Canadian program or increase the level of participation in existing international systems, to ensure a greater exchange and application of accident lessons learned in Canada. Other industries and all levels of government should be encouraged to participate whenever appropriate. (Federal: E, L, T; Provincial: P, E, L, T; Industry)

Chemical Training for First Responders

Conclusion 10. In the event of a chemical accident, first response is usually provided by the local company, police or fire department. While company officials may be knowledgeable about the chemicals at a particular site, firefighters and police in many situations do not have the benefit of this training. Further, many firefighters are volunteers who may never have had the experience of handling a chemical accident.

While there are teaching facilities for on-scene commanders and firefighters, it is impractical to train every officer or even a few on each force to be knowledgeable about all of the hazardous chemicals in Canadian commerce. What is most crucial is to train the first responder how to access chemical expertise, such as may be available locally, or as provided by CANUTEC, the Transportation Emergency Assistance Plan (TEAP), major railways (CN and CP) and the 24-hour emergency spill reporting networks available in each province.

Recommendation 10

(a) For their own protection, and for the protection of the communities they serve, first responders should be trained to access chemical expertise before attempting to control unfamiliar chemicals or mixtures. (Municipalities)

(b) Agencies responsible for providing this chemical expertise should ensure that their programs are widely known by all first responders. (Federal: E, P, T; Provincial: E, P, T)

(c) In those municipalities where hazardous chemicals are manufactured, used or transported, the training of first responders should be continually upgraded and carried out with industry wherever possible. (Municipalities; Industry)

Buffer Zones

Conclusion 11. Municipal land use planning is a means available for providing distance between industrial chemical operations and residential areas. Such buffer zones can help to diminish adverse impacts on the community from major industrial accidents. In many Canadian municipalities, residential areas have spread to the fencelines of industrial or storage sites leaving little or no buffer space. This is largely because there are many pressures on local officials to allow land designated as a buffer zone to be developed, or because residential development occurred before land-use planning came into effect.

On the other hand, some senior governments have assisted municipalities by providing guidance and resources to ensure that plants that manufacture or use hazardous materials are located away from residential areas.

Recommendation 11

(a) Municipalities should introduce zoning regulations to create buffer zones between residential areas and new or existing (when possible) industrial sites. (Municipalities)

(b) Senior governments should increase their efforts to assist municipalities in siting new installations that handle chemicals away from residential areas. (Provinces)

(c) Where existing industrial plants dealing with hazardous chemicals, are already located in close proximity to residences, such plants should examine the feasibility of producing less hazardous chemicals at that site, make a concerted effort to conduct more frequent safety audits, and develop contingency plans on a priority basis in conjunction with local authorities. (Municipalities; Industry)

Dangerous Goods Routes

Conclusion 12. A few municipalities have established designated routes for dangerous goods, particularly highways to prevent such traffic from going through heavily populated areas, as a preventive measure. Other communities are studying this possibility.

Recommendation 12

Governments at all levels should examine the need for legislation or guidelines to establish traffic routes for dangerous goods to minimize the risk of public exposure. (Federal: T; Provincial: T; Municipalities; Industry)

Community Awareness/ Emergency Response

Conclusion 13. One of the important lessons to come out of the Bhopal experience is the importance of ongoing good relations and the ability to communicate quickly between local industry and neighbouring communities regarding safety and response programs. While some industries have initiated this dialogue on their own or as a group, further work is needed by companies in the petroleum and chemical industries and in other industries using or moving hazardous chemicals to improve the level of community awareness and readiness and to ensure contingency plans are compatible with those of the nearby municipalities.

Programs such as that described in the Chemical Manufacturers Association's "Community Awareness and Emergency Response Handbook (CAER)" could be used as the basis for developing Canadian versions. Through the Lambton Industrial Society and local officials, such a program is now being implemented in Sarnia and will eventually be integrated into the Chemical Valley Emergency Control Organization's plan.

Governments have an obligation to encourage their officials to seek hazard information, and to participate with industries in preparing mutually-supportive contingency plans and warning systems for public response in case of major chemical accidents at nearby plants and in transportation corridors.

Recommendation 13

(a) The Canadian Chemical Producers' Association and other appropriate industrial associations should develop programs for their companies based on the principles of the Community Awareness and Emergency Response Program developed by the U.S. chemical industry. CCPA members should pass on the principles of this program to their major customers and other industry associations. (Industry)

(b) Municipal governments should become aware of the potential chemical hazards that exist in their communities and, working with other levels of government, ensure that resources are provided to establish adequate public protection measures. (Federal: P, E; Provincial: P, E; Municipalities; Industry)

(c) Working together, industry and local governments, aided by representative associations such as the Canadian Chemical Producers' Association and the Federation of Canadian Municipalities, should establish closer liaison and develop formal programs for community awareness and emergency response. (Industry; Municipalities)

(d) Municipalities/provinces through existing emergency response associations, should establish the need for a public warning in case of a localized, rapidly developing events such as a Bhopal-type

incident. (Federal: P; Provincial: P; Municipalities; Industry)

Emergency Planning Support

Conclusion 14. In some provinces, emergency response planning is left to the discretion of the municipalities without the active support or guidance of provincial or federal agencies. As a result, many municipalities, because of resource limitations, are not in a position to deal effectively with major chemical incidents.

Recommendation 14

Where such arrangements do not currently exist, provincial agencies, with the assistance of federal departments as necessary, should:

(a) provide guidance to the municipalities on how to prepare emergency response plans (Provincial: E, P);

(b) provide financial support to those small municipalities which cannot develop or implement emergency response plans with their own resources (Provincial: E, P);

(c) maintain inventories of emergency response equipment and be able to assist in the coordination and allocation of equipment and manpower in the event of major incidents (Provincial: E, P).

Chemical Incident Simulation Exercises

Conclusion 15. While many municipalities across Canada have emergency plans to respond to major incidents, very few emergency organizations hold simulation exercises to test the adequacy of their plans. The Chemical Valley Emergency Control Organization in Sarnia and FORT MAP (the mutual aid response organization in Fort Saskatchewan) both hold annual simulations; their programs could be used as models for other emergency organizations.

Recommendation 15

To ensure the adequacy of emergency response plans, all emergency organizations should periodically carry out exercises to simulate an incident, evaluate the effectiveness of the response and make improvements where necessary. (Federal: E, P, T; Provincial: E, P; Municipalities; Industry)

Coordination of Legislation Pertaining to Hazardous Chemicals

Conclusion 16. Legislation dealing with safety and prevention of accidents, both in the work place and in transport, is well established in Canada. Regulations dealing with hazardous commodities, specifically in the areas of occupational health and transport, are continually under review and updated in light of new information. Occupational health and safety legislation is for the most part the responsibility of the provinces, with some programs such as the Workplace Hazardous Materials Information System Program (WHMIS) being coordinated nationally by the Federal Department of Labour. Provinces will also become responsible for implementation of the Transportation of Dangerous Goods Regulations.

While there appears to be adequate safety legislation in place, some confusion may arise as to who has responsibility for various activities in various jurisdictions. For example, the procedures for obtaining appropriate permits vary considerably from province to province. Certain provinces have established interdepartmental committees to ensure that legislation and program activities are co-ordinated.

Recommendation 16

Federal and provincial governments should examine the coordination of legislation and programs particularly in relation to the prevention of major industrial accidents

within their jurisdictions to ensure that gaps do not exist. (Federal: P, E, L, H, T; Provincial: P, E, L, H, T)

Technology Development

Conclusion 17. Countermeasures technology for Bhopal-type incidents is very limited. Although some measures and equipment are available to prevent medium-sized events from escalating into major incidents, increased efforts are needed to expand the frontiers of this technology and to assess and widen the application of existing technology. Greater consultation and broader participation by industries and governments would make this research program more effective.

Recommendation 17

(a) Environment Canada should continue its work as the federal focal point for research and development related to chemical spill countermeasures. It must also continue to monitor and participate in relevant spill technology projects undertaken elsewhere in the world relating to existing high priority toxic chemicals and other chemicals identified as having potential to create Bhopal-type incidents. However, increased input on needs and priorities identification should be sought from federal, provincial, municipal and industrial users of the technology. (Federal: E)

(b) The petroleum and chemical industries should continue to participate with Environment Canada in relevant research projects both for Bhopal-type chemicals and other spill problems. Industry associations should further encourage the marketing or sharing of useful information where the research and development is being done by individual companies. (Federal: E; Industry)

(c) Groups of chemical companies producing or using products having similar properties or behaviour should pool their resources and undertake jointly, or in cooperation with Environment Canada specific new countermeasures projects for Bhopal-type chemicals and other priority chemicals having medium-to-major spill potential. (Federal: E; Industry)

Emergency Medical Treatment

Conclusion 18. Hospital and medical staff are well-prepared to handle accidents involving household chemicals or poisons. However, readily-available information required for emergency medical treatment of mass casualties from a chemical release, chemical fumes and combustion products appears to be lacking in many areas of the country.

Recommendation 18

(a) The Department of Health and Welfare should lead a federal/provincial study group, including professionals in emergency medicine, to clarify and consolidate information for emergency medical treatment and first aid for victims of chemical accidents, and those exposed to combustion products of chemical fires. A secondary task of this group would be to review training and planning aspects of mass casualty care particularly as they relate to a major chemical incident. This group should also identify shortfalls in the information base and seek sponsors/funding for projects to fill in the missing information. This information should be distributed to hospitals, poison control centres and emergency clinics, as well as medical teaching institutions and first aid training organizations

such as St. John's Ambulance. (Federal: H; Provincial: H)

(b) The establishment of a national emergency medical aid response centre or regional centres should be considered by this group. (Federal: H, E; Provincial: P, H, E)

Advanced Emergency Preparedness Activities

Conclusion 19. Canada's immediate priority in emergency preparedness is the development of adequate contingency plans and emergency response systems. Beyond this, further advances could be made in the areas of:

(a) airborne chemical dispersion modelling and improvements in public warning systems;

(b) methods for objectively assessing emergency response capability; and

(c) programs for career development of professional emergency planners.

Recommendation 19

(a) Public protection decisions require knowledge by local authorities of expected movement of airborne chemical clouds, and an ability to warn residents quickly. To assist local authorities in public protection, realistic trajectory modelling should be available, together with alarm systems for all areas where major incidents may occur. (Federal: P, E; Provincial: P, E; Municipalities; Industry)

(b) A study, with provincial, municipal, federal and industrial participation, should be initiated by agencies concerned with emergency preparedness to determine the feasibility of an objective measurement system for emergency response capability. If feasible, the system should be developed

and applied at all levels of government. (Federal: E, P; Provincial: E, P; Municipalities; Industry)

(c) A continuing program for the further education and professional career development of emergency managers and planners should be developed in Canada, as a joint federal/provincial project, in consultation with industrial and municipal emergency planners. (Federal: P, E; Provincial: P, E; Municipalities; Industry)

Professional Safety Training

Conclusion 20. Safety practices and loss prevention programs are a part of an evolving science and new technology. It is important to keep abreast of all the innovations and international experience.

Recommendation 20

Scientific and engineering professionals should receive training in accident and loss prevention. Industrial management courses should address safety as an integral part of the manager's range of responsibilities. (Industry; Universities)

"Right-to-Know" Legislation

Conclusion 21. The Steering Committee received comments from several interested parties suggesting that this "Bhopal Review" should more specifically address the issue of "right-to-know". The comments ranged from the immediate need for legislation at the provincial and/or federal level in this area to the reliance on voluntary sharing of information with those public officials who need and can use the data, to the attitude that "the public would not know what to do with the information anyway".

The Steering Committee was not able to identify any existing legislation under which the federal government could act. We are aware of some of the initiatives in the United States, as well as the City of

Vancouver Dangerous Goods By-Law and legislation proposed by several municipalities such as the City of Toronto. While we respect the concern that development of differing legislative requirements at the municipal level could possibly be burdensome to industry and that therefore senior governments should take the initiative, the Steering Committee concludes that, due to legal and constitutional concerns, the issue needs further study.

Recommendation 21

The issue of "right-to-know" with all its various facets should be examined in a separate study involving governments (at all levels), industry and representatives of environmental and public interest groups.

PART I

POTENTIAL

Report of Working Group 1

An Examination of the Potential for Major Industrial Incidents in Canada

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The Chairmen of the other two Working Groups acted as observers for this group.

SUMMARY

This report presents an assessment of the potential for major incidents involving chemicals, natural gas and petroleum in Canada. Bhopal and its aftermath of human suffering has taught the lesson that society must be always on the alert to identify potential hazards and take all practical steps to minimize the probability of their occurrence.

Since it is virtually impossible to prepare an all inclusive list of likely candidate chemicals for a Bhopal-type incident, Working Group 1 directed its efforts to defining hazard criteria for selecting chemicals that could have such a potential. An example list of such chemicals is provided. The Working Group also examined chemicals that have a high probability of release according to historical spill data.

The risk of an accident associated with handling of these commodities, is a function of the hazard and the probability of such an event occurring. Methodologies for assessing such risks exist, are highly technical in nature and require trained expertise to carry them out. The Working Group urges local industry to carry out site specific assessments on chemicals meeting the Bhopal hazard criteria. Steps should then be taken to effectively manage the risk and to communicate such actions to appropriate community officials and involved publics.

As a general conclusion and in response to the question, "Can it happen here?" the Working Group's analysis of the Canadian situation indicates that the possibility for a major industrial incident does exist. However, when the risks are properly evaluated and managed and a backup contingency plan provided for any emergency should it occur, then the probability of a major incident occurring and the impact on the community will be significantly reduced.

1 INTRODUCTION

The potential for Bhopal-type incidents to occur in Canada is examined in this report. Canadians have been made aware of recent major industrial accidents that have taken place around the world, such as in Seveso (Italy), Mexico City and most recently Bhopal. Incidents closer to home such as the Mississauga (Ontario) train derailment and the natural gas blowout at Lodgepole (Alberta) have alerted everyone to the fact that Canada may be not immune to such major disasters.

The Bhopal Aftermath Steering Committee established Working Group 1 in order to determine the potential for major industrial accidents in Canada. This Group was given the following terms of reference:

1) to identify the chemicals and substances which have been or have the potential to be involved in Bhopal-type incident spills and accidents in Canada;
2) to quantify these chemicals and substances according to their shipments/production (i.e., volume supply as well as hazard);
3) to identify major uses, manufacturing and storage sites for these chemicals in Canada; and
4) to determine major modes of transport for these chemicals.

Although all industrial accidents large or small are undesirable, wasteful in many ways and a potential burden on the resources of a community, the primary focus of this report will be on major chemical accidents as defined by the Steering Committee and used by the Working Groups.

A "Bhopal-type" incident is considered here to be a major industrial or transportation incident resulting in acute exposure to a chemical which has the potential to cause death or adverse health effects in the community.

The working group excluded in its investigation:

1) Strategic chemicals used by the Department of National Defense. However, DND is urged to apply the principles presented in this report to conduct risk assessments, to take appropriate preventative measures and to prepare emergency response plans.

2) Radioactive substances in nuclear facilities. The Atomic Energy Control Board regulates and controls the use and disposal of radioactive substances. Other chemicals handled in or associated with nuclear facilities that meet the "hazard criteria", such as hydrogen sulphide, are included.

3) Offshore drilling and producing platforms are regulated by Energy, Mines and Resources (Canadian Oil and Gas Lands Administration); accidents involving chemical releases from these facilities usually would have limited impact on the general public.

4) Sabotage or acts of terrorism.

The types of major chemical accidents that this report addresses are:

a) explosions from a chemical manufacturing plant, oil refinery, on-shore oil or gas wells or storage facility;
b) an inadvertent release of an acutely toxic gas from a manufacturing site, on-shore oil or gas wells or storage facility;
c) misuse of chemicals causing a toxic release (e.g., accidental mixtures); and
d) transportation accidents releasing large volumes of hazardous chemicals.

Working Group 1 is comprised of members of the petroleum and chemical industries and federal departments having direct or indirect involvement with these industry sectors.

The report examines in a qualitative way the potential for major chemical accidents to occur. For releases of industrial chemicals in use, two approaches are taken: the first looks at chemicals already identified as dangerous commodities in Canada, and the second reviews historical chemical spill data in this country.

2 BACKGROUND ON MAJOR INDUSTRIAL SECTORS

The three major industrial sectors that are the primary producers of the chemicals involved in this study are described in this section.

2.1 Oil and Gas Production Sector

Over 65 major companies active in the oil and gas production sector are represented by the Canadian Petroleum Association. In addition, many other companies carry out independent exploration and drilling. In 1984, in Alberta alone, there were almost 6000 drilling completions with additional activity in British Columbia, Saskatchewan and Manitoba.

The major concern in this sector is the drilling operation, where the unknowns are considerable compared with those in pipelines and gas plants. Pipelines and gas plants may still present a potential risk but preventive measures can be better engineered and implemented than for drilling operations. Tracers can be used on pipelines to detect leaks and gas plants are really a chemical process industry which can be designed and operated using the techniques described in Part II.

In drilling a sour gas well, the unexpected release of hydrogen sulphide (H_2S) poses the major chemical hazard. Wells where the concentration of hydrogen sulphide in the gas exceeds 5% and the gas contains high volumes of condensate are considered "critical sour wells"; therefore, special precautions must be taken. These precautions include, amongst other things, a more comprehensive monitoring and inspection plan, and an accident contingency plan. As will be discussed in Parts II and III, procedures now call for ignition of the well once it is considered "wild".

The scientific debate continues as to the safe exposure limits for hydrogen sulphide. The summary and recommendations report for the Lodgepole Blowout states:

> "The protection plan was designed to ensure that if an H_2S concentration of 15 parts per million (ppm) was reached in any area where people were residing, then they would leave the area. Additional standards were identified for persons described as "sensitive", which generally was taken to mean persons with respiratory problems, very young children, the elderly, and pregnant women. However, for various reasons, these additional standards, while acknowledged, were not actually applied.
>
> The monitoring data gathered during the event shows that the dispersion of the gas cloud from the well was actually quite rapid, notwithstanding the large volumes of H_2S gas being emitted. For

> example, no concentrations in excess of 10 ppm were found at any residences located farther than 20 km from the well, and there were only a few instances inside that 20 km radius. The highest concentration recorded at Cynthia was 14 ppm, at Lodgepole 14.5 ppm, and 5 ppm at Drayton Valley, some 45 km from the well. The highest reading in Edmonton was 0.5 ppm.
>
> Throughout the 26-day period that the well was not on fire, H_2S concentrations were generally low. For example, at Lodgepole, the concentrations were less than 1 ppm for 87 percent of the recorded hours, while at Cynthia and Drayton Valley they were less than 1 ppm for about 95 and 96 percent of the time, respectively. In Edmonton, though the odour was detected, the H_2S concentrations were actually less than 0.1 ppm for 93 percent of the time." (Lodgepole Blowout Report, 1985).

Health effects were evident as stated in the "ERCB Lodgepole Blowout Report - Causes, Effects, Actions":

> "Local area residents, and a group of Edmonton respiratory patients, described how the blowout had affected their health. The effects included headache, eye irritation, sore throat, nose bleeds, some breathing problems, nausea and diarrhea. While scientific data was not available to link these health problems to the blowout, the Panel is satisfied that emissions from the well did lead to short-term health effects for a substantial number of people. The evidence also suggests that some people are especially susceptible to H_2S emissions."

Another potential concern was sulphur dioxide. "During the 41 days that the well was on fire, and the sulphur was being emitted as sulphur dioxide, the concentrations were substantially less than the evacuation limit." (Lodgepole Blowout Report, 1985).

Since Lodgepole, many steps have been taken including establishing exposure limits, improving monitoring techniques and conducting drilling operations in the critical zone in a more cautious manner. The potential for chemical releases does exist from well drilling, pipelines and gas plants and adequate precautions to minimize the risks must be implemented.

2.2 Petroleum Refining Sector

The Canadian petroleum refining industry processed 225 800 m^3 of crude per day in 1984. Fifty-five percent of this production was located in Ontario and Quebec, Alberta accounted for some 12% and the remaining 33% was distributed between British Columbia, Saskatchewan and the Maritimes (Oilweek, 1985).

In the past five years there has been a considerable decrease in refined oil product demand due largely to energy conservation measures. This has resulted in the

closure of some 10 refineries so that today there are only 28 operating. These refineries are distributed across Canada from Nova Scotia to Vancouver and several are located in urban areas close to residential communities.

The potential for major accidents associated with petroleum refineries and the downstream product distribution system is generally in the form of fire or explosions. Not as likely, but still a possibility under certain local conditions, is a toxic release of hydrogen sulphide gas from refineries.

Historically the Canadian refining industry has a good safety record with only isolated major accidents reported. The last major Canadian incident took place in 1957 at a Montreal East refinery where an explosion and fire was initiated by butane release from a storage sphere (Journal of Hazardous Materials, Vol. 3, 1979). More recently, refineries at Clarkson, Ontario (1975), and Dartmouth, Nova Scotia (1985), were involved in incidents resulting in releases to the surrounding communities of hydrofluoric acid in one case and hydrogen sulphide in the other.

In the United States such events are comparatively more frequent with the latest incident reported on November 5, 1985, when an explosion and fire occurred at a petroleum refinery and storage facility near Houston, Texas. Two workers were killed and over 1 700 people in the nearby community had to be evacuated.

2.3 Chemical Industry Sector

The Canadian Chemical Industry is generally organized along product lines. Chemical companies therefore group together in different associations such as: the Canadian Agricultural Chemical Association, the Canadian Fertilizer Institute, the Canadian Manufacturers of Chemical Specialties Association, Society of Plastics Industry, and the Canadian Paint and Coatings Association to represent their specific interests. The majority of chemical manufacturers is represented by the Canadian Chemical Producers' Associations (CCPA) which is made up of 65 member companies that produce a broad range of petrochemicals, inorganic chemicals and other specialty chemicals.

The chemical industry is the fifth largest industry in terms of value of product output. As is the case with the petroleum refining sector, chemical manufacturing plants are located throughout Canada. Most of the chemicals supplied are manufactured in Ontario, principally in Sarnia's "Chemical Valley", and in Alberta in the Fort Saskatchewan area.

The chemical industry supplies a network of secondary industries such as: textiles, manufacturers of plastic goods, automotive supply, pulp and paper and mining.

This is significant because major chemical users could also be involved in major chemical accidents.

As discussed in Part II, the chemical industry has a good record of accident prevention when compared to all industries. In addition members of CCPA have adopted a policy of "Responsible Care" which addresses product stewardship throughout the chemical lifecycle, from development, introduction, manufacture, transportation, storage, handling and ultimate disposal in order to minimize the possibility of adverse effects on human health, well-being and the environment (Petrochemical Industry Task Force Report to the Federal Minister of Regional Industrial Expansion, 1984).

Similarities exist between petroleum refinery and chemical plant operations except that chemical plants generally tend to be smaller in size and certain chemicals produced present a higher toxicity hazard. Section 3 of this report describes the criteria necessary to evaluate the degree of hazard of these chemicals.

3 ASSESSMENT OF RISK

In order to deal with the vast array of chemicals in Canadian commerce and determine those chemicals that would logically fall into a Bhopal-type incident grouping, the process shown in Figure 1 was used. The Transportation of Dangerous Goods Act (TDGA) criteria for listing dangerous chemicals provides what could be termed a prospective approach and permits the identification of hazardous chemicals before an accident. An analysis of historical data would be a retrospective approach and facilitates priority setting to deal with the most accident prone chemicals. Together they provide an overview of the potential dangerous chemicals in Canada.

3.1 Prospective Approach

In any analysis of chemical accidents, we must consider the element of risk. Risk, in engineering terminology, is defined as the product of hazard and the probability of its occurrence (Krewski et al., 1984). The hazard is a function of the physical, chemical and toxicological properties of substances. The probability in turn is a function of the likelihood of occurrence of an event or sequence of events that gives rise to the release of a chemical and the mechanism by which the population is exposed. It should be noted that these definitions vary from one scientific discipline to another (e.g., engineering and biology) (Royal Society, 1983).

3.1.1 Hazard Criteria. In attempting to identify the chemicals that have a potential for a Bhopal-type incident, it is necessary to define the selection criteria on a scientific basis. Once the criteria are set, it is then possible to screen any chemical in use in Canada for its potential to cause a major public disaster.

In establishing these criteria, a review of criteria used by other jurisdictions such as the United Kingdom, the United States and those already in existence in Canadian legislation, (i.e., the Transportation of Dangerous Good Act) was undertaken (Canada Gazette, 1985). As the TDG Regulations were put into effect in July, 1985 and prior to that had undergone a thorough scientific review by industry and government at various levels, Working Group 1 decided that this was the most logical starting point for this review.

It should be noted that the approach taken by U.S. EPA differed in that they started with a long list of chemicals which could cause acute toxic effects. In Canada this was already done under the TDG Regulations.

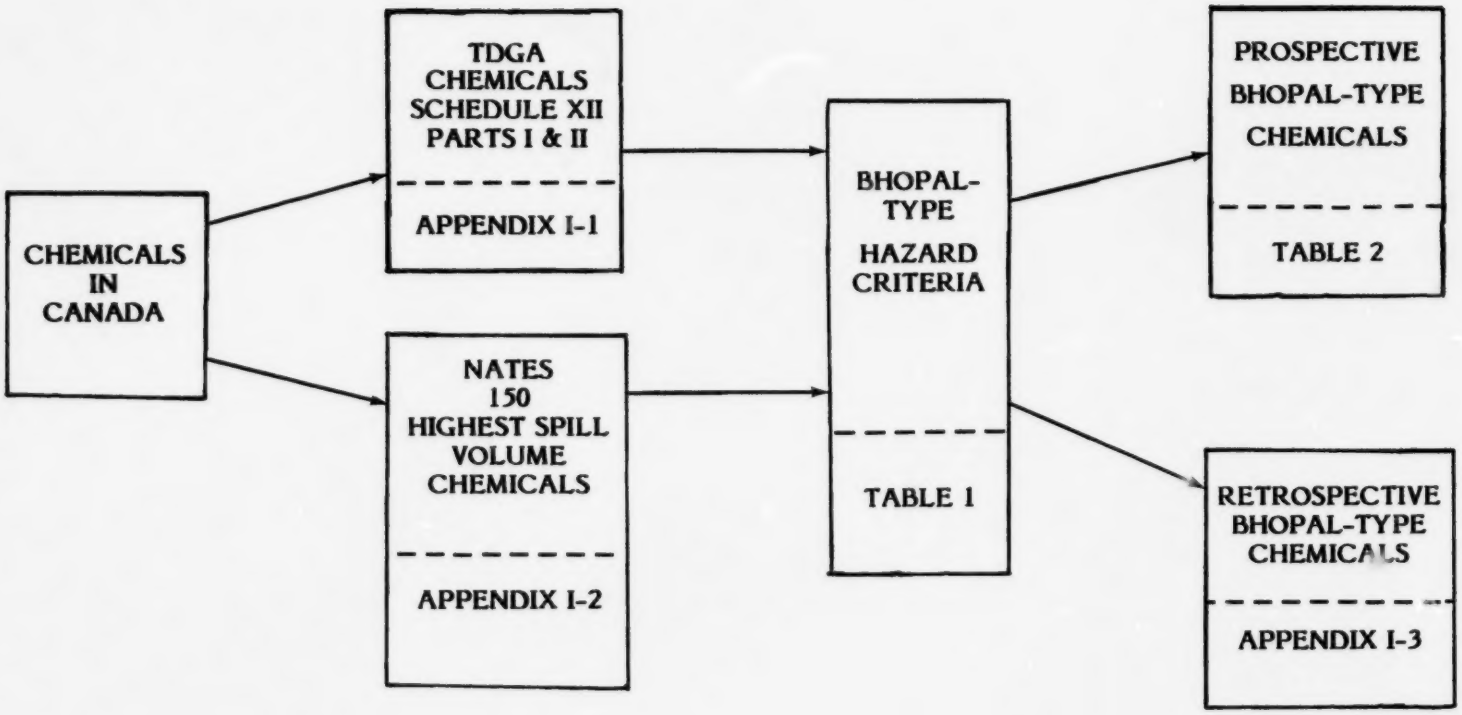

FIGURE 1 PROCESS FOR IDENTIFYING BHOPAL-TYPE CHEMICALS

The TDG Regulations list some 2400 dangerous goods. Schedule XII - Parts I and II of these regulations further refines the list of hazardous chemicals to those with a potential risk to human health or the environment during a spill situation or an explosion. The toxic chemicals that could migrate well beyond the borders of the transportation corridor's right-of-way fall into this classification. Using this criterion, the Schedule XII - Parts I and II listing is reduced to some three hundred chemicals for which spill response plans are required. This gives a list of three hundred dangerous chemicals used in Canadian commerce (see Appendix I-1). Chemicals on this list can be further examined to identify those that could possibly give rise to a Bhopal-type incident, i.e., the physical, chemical and biological characteristics of a substance that could produce such effects must be identified. Properties that could lead to a major industrial incident are:

1) a poisonous gas or aerosol that has good dispersive properties or is contained in a pressured system;
2) a highly flammable gas or liquid with an explosive potential;
3) a highly reactive material that combines violently and generates toxic products; and
4) a chemical that generates a toxic gas when it burns.

In this study, only chemicals that produce lethal or adverse health effects upon exposure are considered. Substances that may lead to only chronic effects (i.e., long-term health effects) are not within the scope of this study. The hazard criteria for potential Bhopal-type incidents chemicals are listed in Table 1.

3.1.2 Probability. The risk of a particular chemical producing a Bhopal-type incident is also a function of the probability of a chain of events or conditions occurring so as to allow the chemical to come in contact with the population at large.

An assessment of probability is made on a site or situation specific basis. Whereas potential hazard identification using established criteria is objective (i.e., based on measurable scientific data), the probability is often complex, requiring subjective judgement. As an example, the following factors must be considered in arriving at the probability estimate:

1) volume of chemical present at any one time (there is a minimum quantity below which the risk is too low to produce a Bhopal-type incident; by rule of thumb for railways this is considered a car-load quantity);
2) conditions of confinement (temperature, pressure, etc.);
3) conditions of storage;

TABLE 1 HAZARD CRITERIA FOR BHOPAL-TYPE INCIDENT CHEMICALS

Group	Hazard	Criteria
I	Toxic substances (Class 2, Divisions 3 and 4 TDGR)	Toxic gases and/or Toxic liquids under pressure that will easily evaporate or form aerosols and that meet LC_{50} < 5 000 mL/m^3 provided they possess good dispersive properties.
II	(A) Flammable gases (Class 2, Division 1 TDGR)	a) Flammable gases Gases which at normal pressure when mixed with air are flammable, i.e., (i) ignitable at normal atmospheric pressure when in a mixture of 13 percent or less (ii) have a flammability range of at least 12
	(B) Flammable liquids (Class 3, Divisions 1, 2 and 3 TDGR)	b) Flammable liquids Substances having a flash point < 37.8°C
III	Explosive substances (Class 1, Divisions 1 and 5 TDGR)	Substances which can explode under fire or shock situations.
IV	Reactive substances producing toxic, dispersible materials or fires or explosions (Class 4, 5, 6 or 9 TDGR)	Substances which, on burning or reacting in a violent manner, produce a product of reaction listed under Group 1 (Toxic Substances) or produce a serious fire or explosion. - flammable solids - substances liable to spontaneous combustion - substances that on contact with water emit flammable gases - oxidizing substances and organic peroxides - poisonous dust or mist emissions with LC_{50} < 500 mg/m^3 at normal atmospheric pressure

4) equipment and system engineering design criteria;
5) manufacturing process or method of use (including an analysis of intermediates and potential mixtures);
6) routine safety precautions taken;
7) reliability engineering principles and techniques in use at the location;
8) secondary containment employed;
9) possibility of process upsets (particularly start-up and shutdown procedures);
10) maintenance practices;
11) probable atmospheric conditions at location (wind speed, inversions, etc.); and
12) population density at the location.

The analysis of factors becomes more difficult for those involved in transportation as roads, rail and even canals and harbours can either pass through or near dense population areas in Canada.

The above probability factors are presented only by way of example, since each situation is unique and must undergo an individual risk assessment by specialists in the field. Such an approach is termed prospective, since it attempts to forecast risk on a predictive basis using local parameters. Table 2 gives examples of some of the substances that under the appropriate conditions, and in sufficient quantity, could result in a Bhopal-type incident. **This table should not be considered a comprehensive or a priority listing.**

3.2 Retrospective Approach

Another approach, called retrospective, is based on historical records. By examining accident statistics, it is sometimes possible to assign probability and therefore estimate risk.

The Environmental Protection Service of Environment Canada has developed a data base of spill statistics over the past fifteen years known as the National Analysis of Trends in Emergencies System (NATES) (Figure 2). This data base now contains twenty-three thousand spill events involving petroleum products and chemicals.

These statistics indicate that a hundred and fifty chemicals make up 97 percent of the spill volume. As shown in Figure 2, spill volume also correlates well with the supply volume (sum of production and importation of chemicals).

The relationship of spill or supply volume and number of chemicals can be usefully applied by screening the list of 150 most spilled chemicals through the Bhopal-type hazard criteria (Appendix I-2). In this way, it is possible to identify those chemicals that historically have a high probability for involvement in a Bhopal-type incident

TABLE 2 EXAMPLES OF BHOPAL-TYPE INCIDENT CHEMICALS IN CANADA

Substances	Transport Class	Product Identification Number
Group 1 - Toxic Substances		
Ammonia	(2.4 and 9.2)	1005
Arsine	(2.3 and 2.1)	2188
Chlorine	(2.4 and 9.2)	1017
Hydrogen Chloride	(2.4 and 9.2)	1050
Hydrogen Fluoride	(2.4, 6.1, 9.2)	1052
Sulphur Dioxide	(2.3)	1079
Group 2 - Flammable Substances		
(a) Flammable Gases		
Natural Gas	(2.1)	1971
Propane	(2.1)	1978
Ethylene Oxide	(2.1 and 6.1)	1040
Hydrogen Sulphide*	(2.1, 6.1, 9.2)	1051
Methane	(2.1)	1971, 1972
Butane	(2.1)	1011
Ethylene	(2.1)	1962, 1038
Hydrogen	(2.1)	1049, 1966
Propylene	(2.1)	1077
Vinyl Chloride	(2.1)	1086, 1060
(b) Flammable Liquids		
Hydrazine	(3.3 and 6.1)	2029
Propylene Oxide	(3.1 and 9.2)	1280
Carbon Disulphide	(3.1, 6.1 and 9.2)	1131
Group 3 - Explosive Substances		
Ammonium Nitrate	(1.1)	0222
Group 4 - Substances with Toxic Products of Reaction (Classes 4,5,6,8 and 9)		
Phosphorous	(4.2 and 9.2)	2344
Sodium Cyanide	(6.1 and 9.2)	1689

* H_2S is also a toxic substance

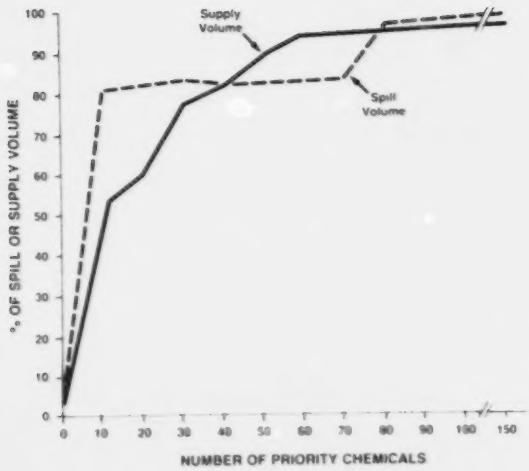

FIGURE 2 "NATES" CHEMICALS RELATED TO SPILL OR SUPPLY VOLUME

(Appendix I-3). The production, uses, transport and hazard associated with some of these chemicals are presented in Appendix I-4.

It cannot be overstressed that these lists are not intended to be all inclusive and should be used with caution. For one thing, the list of accidents included in NATES is far from complete. It was recently reported that fire departments in Ontario responded to over 4 600 spills in 1984. (Office of the Fire Marshall, Ontario). This exceeds the number of spills recorded in NATES for all of Canada by a factor of 3 to 4.

There is an obvious need to improve the spill reporting frequency across Canada. TDG Regulations should do this for transportation incidents. Other measures may be required for on-site spills.

Working Group 1 supports the stand taken by the U.S. Science Advisory Board that a short priority list of Bhopal type chemicals may be misleading and counterproductive, giving society a false sense of security (Bureau of National Affairs, Aug. 85).

In light of this, Working Group 1 recommends that Canadian industries, communities and safety agencies conduct site specific assessments based on risk factors and hazard criteria identified in Table 1 of this report, rather than relying solely on the chemicals listed in Table 2 or in Appendix I-3.

Excellent reference documentation is available for use by communities and local industries on this subject. We would particularly like to draw attention to the following:

1) "Evaluation of Public Health Hazards Associated with Chemical Accidents", 2nd Edition, V. Silvano (1985).
2) "Chemical Emergency Preparedness Program: Interim Guidance". U.S. Environmental Protection Agency (November 1985).
3) "Community Awareness and Emergency Response". Chemical Manufacturers Association (April 1985).
4) "Guidelines for Hazard Evaluation Procedures". American Institute of Chemical Engineers, Batelle, Columbus (December, 1985).

4 SPECIAL CHEMICALS AND CONSIDERATIONS

As mentioned earlier in this report, Working Group 1 has concerned itself primarily with chemicals that may present an acute hazard of significant size. This implies the existence of a sufficient quantity of the dangerous chemical in order to pose such a potential level of risk. This will vary from chemical to chemical and is highly situation specific.

There are however, certain chemicals that although they do not fall within this category, have attracted such wide media attention that the Working Group agreed to provide comment. The following is a brief description of the reasons why pesticides, polychlorinated biphenyls and dioxin have been given special consideration.

(i) Pesticides

As a class of chemical agents pesticides are by definition poisonous to a large variety of organisms. They are used to control insects, fungi, weeds and pests. As with any poison they pose a threat to human health or the environment if they are misused. Every year there are reports of spills and poisonings involving pesticides that are usually the result of transport accidents or product misuse.

A review of the Canadian situation showed that primary manufacturing of the active ingredients in pesticides is carried out at only one or two locations. There are a number of formulating plants in Canada, however where imported active ingredients are combined with other chemicals to form the pesticide product. Since it was impossible to characterize the hazard posed by these chemical mixtures or to establish the critical quantities required to pose a public threat, the Working Group concluded that pesticides would have to be evaluated on a case-by-case basis. The only potential for Bhopal-type disasters likely to occur from these chemicals would be in transport accidents or storage fires where plumes of toxic gases could potentially be dispersed over a wide area.

(ii) Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls have been widely publicized as environmental and human health contaminants. As of 1980 the use of PCBs in Canada was severely restricted under the Environmental Contaminants Act. In 1985, Transport Canada passed regulations concerning the transport of PCBs. The phasing out of PCBs in electrical and heat transfer equipment, however, may continue for several years. In all

probability PCB spills or fires would be highly localized and would not be expected to lead to acute human effects. Therefore this class of chemicals was not included on the Bhopal-type chemicals list.

(iii) **Dioxin (2,3,7,8-tetrachlorodibenzo-ρ-dioxin)**

In the early 1980's a great deal of publicity was given to a dangerous chemical by-product that goes by the diminutive name of dioxin. In reality there are 75 compounds that belong to a group of chemicals that collectively are called dioxins. Of these 2,3,7,8-tetrachlorodibenzo-ρ-dioxin is reputed to be the most toxic man-made chemical of all time. It is produced inadvertently in trace quantities in the combustion of certain organic materials and is a by-product of the manufacture of the pesticide 2,4,5, trichlorophenol.

Since this substance is not manufactured in Canada and since the emissions of dioxin from organic waste incineration are in trace quantities usually below the acute hazard level, dioxin is unlikely to cause a major chemical accident in Canada.

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APPENDIX I-1

TRANSPORTATION OF DANGEROUS GOODS ACT HAZARDOUS CHEMICALS WITH DISPERSIVE AND EXPLOSIVE POTENTIAL

APPENDIX I-1 TRANSPORTATION OF DANGEROUS GOODS ACT HAZARDOUS CHEMICALS WITH DISPERSIVE AND EXPLOSIVE POTENTIAL

In the Federal Transportation of Dangerous Goods Act (TDGA), dangerous commodities are categorized into nine classes depending on the type of hazard they present. The classes are further subdivided into divisions and each division separates out the hazard characteristics. A numerical coding is used with the classes numbered 1 to 9 followed by a decimal point and then a division numeral.

The nine classes, their divisions where applicable and a brief description of their characteristics are:

Class 1 - Explosives

1.1 - A substance or article with a mass explosion hazard.

1.2 - A substance or article with a fragment projection hazard, but not a mass explosion hazard.

1.3 - A substance or article which has a fire hazard along with either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

1.4 - A substance or article which presents no significant hazard - explosion effects are largely confined to the package and no projection or fragments or appreciable size or range are to be expected.

1.5 - A very insensitive substance which nevertheless has a mass explosion hazard like those substances in 1.1.

Class 2 - Gases

2.1 - A flammable gas.

2.2 - A non-flammable, non-toxic, non-corrosive gas.

2.3 - A poisonous gas.

2.4 - A corrosive gas.

Class 3 - Flammable Liquids

3.1 - A liquid with a closed-cup flash point of less than -18°C.

3.2 - A liquid with a closed-cup flash point greater than -18°C but less than 23°C.

3.3 - A liquid with a closed-cup flash point greater than 23°C but less than 37.8°C (for international air transport, the flash point is greater than 23°C but lessthan 60.5°C) (for international marine transport, the flash point is greater than 23°C but less than 61°C).

Class 4 - Flammable Solids, Substances Liable to Spontaneous Combustion, and Substances that on Contact with Water Emit Flammable Gases

4.1 - A solid which under normal conditions of transport is readily ignitable and burns vigorously and persistently or which causes or contributes to fire through friction or from heat retained from manufacturing or processing.

4.2 - A substance liable to spontaneous combustion under normal conditions of transport, or when in contact with air, liable to spontaneous heating to the point where it ignites.

4.3 - A substance that, on contact with water, emits dangerous quantities of flammable gases or becomes spontaneously combustible on contact with water or water vapour.

Class 5 - Oxidizing Substances and Organic Peroxides

5.1 - A substance with causes or contributes to the combustion of other material by yielding oxygen or other oxidizing substances whether or not the substance itself is combustible.

5.2 An organic compound that contains the bivalent "-0-0-" structure which is strong oxidizing decomposition or is sensitive to heat, shock or friction.

Class 6 - Poisonous Substances and Infectious Substances

6.1 - A solid or liquid that is poisonous through inhalation of its vapours, by skin contact or by ingestion.

6.2 - Organisms that are infectious or that are reasonably believed to be infectious to humans or to animals and the toxins of such organisms.

Class 7 - Radioactive Materials

- Radioactive materials within the meaning of the Atomic Energy Control Act with activity greater than 74 kBq/kg.

Class 8 - Corrosive Substances

- A substance that causes visible necrosis of skin or corrodes steel or non-clad aluminum.

Class 9 - Miscellaneous Dangerous Goods

9.1 - A substance or product presenting dangers sufficient to warrant regulation in transport but which cannot be ascribed to any other class.

9.2 - An environmentally hazardous substance.

9.3 - A dangerous waste.

SCHEDULE XII - PART I - EXPLOSIVES

Ammonium Nitrate
Ammonium Nitrate Fertilizer*
Ammonium Perchlorate
Ammonium Picrate
Diazodinitrophenol, Wetted
Diethylene Glycol Dinitrate, Desensitized
Dinitrophenol
Dinitroreorcinol
Dipicryl Sulphide
Guanyl Nitrosaminoguanylidene Hydrazine, Wetted
Guanyl Nitrosaminoguanyltetrazene, Wetted or Tetrazene, Wetted
Hexanitrodiphenylamine or Dipicrylamine or Hexyl
Hexanitrostilbene
Hexatonal, Cast
Hexolite
Lead Azide, Wetted
Lead Nitroresorcinate, Wetted
Lead Styphnate, Wetted
Mannitol Hexanitrate, Wetted or Nitromannite, Wetted
Mercury Fulminate, Wetted
5-Nitrobenzotriazol
Nitrocellulose
Nitroglycerin, Desensitized
Nitroglycerin, Spirit of
Nitroguanidine or Picrite
Nitrosoguanidine, Wetted
Nitrostarch
Nitro Urea
Octolite or Octol
Pentaerythrite Tetranitrate, Wetted or Desensitized Pentaerythrit
Pentaerythrite Tetranitrate or Petn
Pentolite
Tetranitroaniline
Trinitroaniline or Picramide
Trinitroanisole
Trinitrobenzene
Trinitrobenzenesulphonic Acid
Trinitrobenzoic Acid
Trinitrochlorobenzene or Picryl Chloride
Trinitro-*m*-Cresol
Trinitrofluorenone
Trinitronaphthalene
Trinitrophenetole
Trinittrophenol or Picric Acid

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* Regulatory requirements under review by Transport Canada and the Canadian Fertilizer Institute.

SCHEDULE XII - PART I - EXPLOSIVES (Cont'd)

Trinitrophenylmethynitramine or Tetryl
Trinitroresorcinol or Styphnic Acid
Trinitroresorcinol, Wetted or Styphnic Acid, Wetted
Trinitrotoluene or TNT
Trinitrotoluene and Trinitrobenzene Mixtures or TNT and Trinitrob
Trinitrotoluene Mixtures Containing Trinitrobenzene and Hexanitro
Tritonal
Urea Nitrate
Ethylene Glycol Mononitrate Solution
Methylamine Nitrate Solution

SCHEDULE XII - PART II

Dangerous goods listed under Part II Schedule XII of the TDGA regulations. (Part II deals with the Application of the Act and identifies under what circumstances the Act does not apply) are those that if there is a spill or emission to the environment the chemicals could potentially migrate outside the transportation corridor's right-of-way.

This list is shown on the accompanying tables. The chemicals on this list were arrived at through a consensus process between senior scientists of both industry and government. This comprehensive list of some 300 chemicals was used by Working Group 1 as a starting point for developing the acutely hazardous list of chemicals having a Bhopal-type potential.

SCHEDULE XII - PART II - CLASS 2.1 - GASES IGNITABLE AT NORMAL ATMOSPHERE WHEN IN A MIXTURE OF LESS THAN 13% (VOL.) WITH AIR OR HAVE A FLAMMABILITY RANGE OF AT LEAST 12

Hydrogen Sulphide, Liquefied or Hydrogen Sulphide
Methane, Refrigerated Liquid or Natural Gas, Refrigerated Liquid
Propane
Butane or Butanes Mixtures
Ethylene, Compressed or Ethylene
Ethylene, Refrigerated Liquid
Hydrogen, Compressed or Hydrogen
Hydrogen, Refrigerated Liquid or Hydrogen, Liquified
Propylene
Vinyl Chloride, Inhibited
Butylenes
Ethylene Oxide
Butadiene, Inhibited
Acetylene, Dissolved or Acetylene
Ethyl Chloride
Aerosols
Carbon Dioxide and Ethylene Oxide Mixtures
Carbon Monoxide and Hydrogen Mixture
Carbon Monoxide
Chlorodifluoroethanes or Difluorochloroethanes
Coal Gas
Compressed or Liquefied Gases, Flammable, N.O.S.*
Compressed or Liquefied Gases, Flammable, Toxic, N.O.S.*
Cyclopropane, Liquefied or Cyclopropane
Deuterium
Diborane or Diborane Mixtures
Dimethyl Ether
Dimethylamine, Anhydrous
Ethane, Compressed or Ethane
Ethane, Refrigerated Liquid
Ethylamine or Monoethylamine
Hydrocarbon Gases, Compressed, or Non-Liquefied N.O.S.* or Hydrocarbon Gases
Hydrogen Gases, Liquefied, N.O.S.* or Hydrocarbon Gases Mixtures, Liquified
Hydrogen and Methane Mixtures, Compressed
Isobutane or Isobutane Mixtures
Isobutylene
Methyl Acetylene and Propadiene Mixtures, Stabilized
Methyl Chloride and Methylene Chloride Mixture
Methyl Chloride
Methyl Fluoride
Methyl Mercaptan
Methylamine, Anhydrous
Oil, Gas

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* N.O.S.: Not otherwise specified.

SCHEDULE XII - PART II - CLASS 2.1 - GASES IGNITABLE AT NORMAL ATMOSPHERE WHEN IN A MIXTURE OF LESS THAN 13% (VOL.) WITH AIR OR HAVE A FLAMMABILITY RANGE OF AT LEAST 12 (Cont'd)

Petroleum Gases, Liquefied, N.O.S. or Liquefied Petroleum Gas
Propadiene, Inhibited
Tetrafluoroethylene, Inhibited
Trifluorochloroethylene, Inhibited
Trifluoroethane, Compressed
Trimethylamine, Anhydrous
Vinyl Bromide, Inhibited
Vinly Fluoride, Inhibited
Vinyl Methyl Ether, Inhibited
1, 1-Diflouroethylene
2, 2-Dimethyl Propane

SCHEDULE XII - PART II - CLASS 2.2 - GASES HAVING A LC_{50} OF LESS THAN 5000 mL/m^3 AT NORMAL ATMOSPHERE BY REASON OF TOXICITY

Arsine
Sulphur Dioxide, Liquefied or Sulphur Dioxide
Boron Trichloride
Boron Trifluoride
Bromine Chloride
Carbonyl Fluoride
Chlorine Trifluoride
Chloropicrin and Methyl Chloride Mixtures
Chloropicrin and Non-Flammable, Non-Liquefied, Compressed Gas Mixture
Chloropicrine and Methyl Bromide Mixtures
Cyanogen Chloride
Cyanogen, Liquefied or Cyanogen, Gas
Dichlorosilane
Fluorine, Compressed or Fluorine
Germane
Hexaethyl Tetraphosphate and Compressed Gas Mixtures
Hexafluoroacetone
Hydrogen Selenide, Anhydrous
Insecticide Gases, Toxic, N.O.S.
Methyl Bromide
Methyldichloroarsine
Nitric Oxide and Nitrogen Tetroxide, Mixtures
Nitric Oxide
Nitrogen Dioxide, Liquefied or Nitrogen Dioxide, Liquid
Nitrogen Oxides, N.O.S.
Nitrogen Trifluoride
Nitrogen Trioxide
Oxygen Difluoride

SCHEDULE XII - PART II - CLASS 2.2 - GASES HAVING A LC_{50} OF LESS THAN 5000 mL/m^3 AT NORMAL ATMOSPHERE BY REASON OF TOXICITY (Cont'd)

Phosgene
Phosphine
Phosphorus Pentafluoride
Selenium Hexafluoride
Silane
Silicon Tetrafluoride
Stibine
Sulphur Tetrafluoride
Sulphuryl Fluoride
Tellurium Hexafluoride
Tetraethyl Dithiopyrophosphate and Gases, in Solution or Tetraethyl Ditiopyr
Tetraethyl Pyrophosphate and Compressed Gas Mixtures

SCHEDULE XII - PART II - CLASS 2.3 - GASES HAVING A LC_{50} OF LESS THAN 5000 mL/m^3 AT NORMAL ATMOSPHERE BY REASON OF CORROSION EFFECTS

Ammonia, Anhydrous, Liquefied or Ammonia Solutions
Chlorine
Hydrogen Bromide, Anhydrous
Hydrogen Chloride, Anhydrous
Hydrogen Chloride, Refrigerated Liquid
Hydrogen Fluoride, Anhydrous
Hydrogen Iodide, Anhydrous
Nitrosyl Chloride

SCHEDULE XII - PART II - CLASS 3.1 - FLAMMABLE LIQUIDS WITH A FLASH POINT OF LESS THAN -18°C

Propylene
Carbon Disulphide or Carbon Bisulphide
Acetaldehyde
Acrolein, Inhibited
Chlordane, Liquid
Flammable Liquids, Corrosive, N.O.S.*
Flammable Liquids, Poisonous, N.O.S.*
Mercaptans, Liquid, N.O.S. or Mercaptan Mixtures, Liquid, N.O.S.

SCHEDULE XII - PART II - CLASS 3.2 - FLAMMABLE LIQUIDS WITH A FLASH POINT OF BETWEEN 23°C AND -18°C

Acetyl Chloride
Acrylonitrine, Inhibited
Arsenical Pesticides, Liquid, Flammable, Toxic, N.O.S.
Bipyridilium Pesticides, Liquid, Flammable, Toxic, N.O.S.
Carbamate Pesticides, Liquid, Flammable, Toxic, N.O.S.
Copper Based Pesticides, Liquid, Flammable, Toxic, N.O.S.
Dimethlhydrazine, Symmetrical or 1,2-Dimethylhydrazine
Dimethyldichlorosilane
Dimethylhydrazine, Unsymmetrical or 1,1-Dimethylhydrazine
Dithocarbamate Pesticides, Liquid, Flammable, Toxic, N.O.S.
Mercaptans, Liquid, N.O.S. or Mercaptan Mixtures, Liquid, N.O.S.
Mercury Based Pesticides, Liquid, Flammable, Toxic, N.O.S.
Methacrylaldehyde
Methyl Cyanide/Acetonitrile
Methyldichlorosilane
Organochlorine Pesticides, Liquid, Flammable, Toxic, N.O.S.
Organosphorus Pesticides, Liquid, Flammable, Toxic
Organotin Pesticides, Liquid, Flammable, Toxic, N.O.S.
Pesticides, Liquid, Flammable, Toxic, N.O.S.
Phenoxy Pesticides, Liquid, Flammable, Toxic, N.O.S.
Phenyl Urea Pesticides, Liquid, Flammable, Toxic, N.O.S.
Triazine Pesticides, Liquid, Flammable, Toxic, N.O.S.

SCHEDULE XII - PART II - CLASS 4.2 - SOLIDS LIABLE TO SPONTANEOUS COMBUSTION

Phosphorus White, Molten
Phosphorus, White or Yellow, Dry or Underwater
or in Solution
Aluminum Alkyl Halides
Dimethylzinc
Ethyl Phosphonous Dichloride, Anhydrous
Fuel, Pyrophoric, N.O.S.
Magnesium Diphenyl
Methyl Magnesium Bromide in Ethyl Ether
Sodium Hydrosulphide, Solid

SCHEDULE XII - PART II - CLASS 4.3 - SUBSTANCES THAT ON CONTACT WITH WATER EMIT FLAMMABLE GASES

Calcium Carbide
Aluminum Carbide
Aluminum Phosphide - Pesticide
Calcium Phosphide
Ethyldichlorosilane
Magnesium Aluminum Phosphide
Magnesium Phosphide
Methyl Chlorosilane
Potassium Phosphide
Sodium Phosphide
Stannic Phosphides
Strontium Phosphide
Trichlorosilane
Zinc Phosphide

SCHEDULE XII - PART II - CLASS 5.1 - OXIDIZING SUBSTANCES

Hydrogen Peroxide, Aqueous Solutions
Hydrogen Peroxide, Stabilized
Bromine Pentafluoride
Bromine Trifluoride
Iodine Pentafluoride
Perchloric Acid
Tetranitromethane

SCHEDULE XII - PART II - CLASS 5.2 - ORGANIC COMPOUNDS THAT CONTAIN THE BIVALENT "-0-0-" STRUCTURE

Acetyl Cyclohexanesulphonyl Peroxide
Cyclohexanone Peroxide(s)
Dibenzoyl Peroxide, or Benzoil Peroxide
Dicyclohexyl Peroxydicarbonate, Technically Pure
Diisopropyl Peroxydicarbonate, or Isopropyl Peroxydicarbonate
Disuccinic Acid Peroxide, or Succinc Acid Peroxide
Di-n-Propyl Peroxydicarbonate
Di-(Sec-Butyl) Peroxydicarbonate
Di-(Tert-Butylperoxy) Phthalate
Di-(2-Methylbenzoyl) Peroxide
Ethyl-3, 3-Di-(Tert-Butylperoxy) Butyrate
Methyl Ethyl Ketone Peroxide(s)
Tert-Butyl Peroxy-2-Ethylhexanoate

SCHEDULE XII - PART II - CLASS 5.2 - ORGANIC COMPOUNDS THAT CONTAIN THE BIVALENT "-0-0-" STRUCTURE (Cont'd)

Tert-Butyl Peroxydiethylacetate
Tert-Butyl Peroxyisobutyrate
Tert-Butyl Peroxyisopropyl Carbonate
Tert-Butyl Peroxypivalate
Tert-Butyl Monoperoxymaleate
1,1-Di-(Tert-Butylperoxy) Cylohexane
2,2-Dihydroperoxy Propane
2,5-Dimethyl-2,5-Dihydroperoxy Hexane
2,5-Dimethyl-2,5-DI-(Benxoylperoxy) Hexane
2,5-Dimethyl-2,5-DI-(Benzoylperoxy) Hexane
2,5-Dimethyl-2,5-DI-(Tert-Butylperoxy) Hexyne-3
3,3,6,6,9,9-Hexamethyl-1,2,4,5-Tetraoxocyclononane
3-chloroperoxybenzoic Acid

SCHEDULE XII - PART II - CLASS 6 - POISONOUS/TOXIC SUBSTANCES WITH LD_{50} (ORAL) 5 mg/kg, LD_{50} (DERMAL) 40 mg/kg, LD_{50} (INHALATION) 500 mg/kg

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Sodium Cyanide
Acetone Cyanohydrin
Aerosols
Azinphos-Methyl Mixture, Liquid
Beryllium, Metal Power
Bromobenzyl Cyanides
Calcium Cyanide
Chloropicrin Mixtures, N.O.S.
Copper Cyanide
Dichlorodimethyl Ether, Symmetrical
Dichlorophenyl Isocyanates
Dinitrobenzenes
Diphenylamine Chloroarsine
Diphenyl chloroarsine
Disinfectants, N.O.S.
Ethyldichloroarsine
Ethyleneimine, Inhibited
Hydrocyanic Acid, Aqueous Solutions
Hydrogen Cyanide, Anhydrous, Stabilized
Medicines, N.O.S.
Mercuric Potassium Cyanide
Mercury Cyanide or Mercuric Cyanide
Methyl Bromide and Ethylene Dibromide Mixtures, Liquid
Motor Fuel Antiknock Mixtures
Nickel Carbonyl
Organophosphorus Pesticides, Liquid, Toxic Flammable
Phenol, Molten

SCHEDULE XII - PART II - CLASS 6 - POISONOUS/TOXIC SUBSTANCES WITH LD_{50} (ORAL) 5 mg/kg, LD_{50} (DERMAL) 40 mg/kg, LD_{50} (INHALATION) 500 mg/kg (Cont'd)

Phenol, Solid or Phenol
Poisonous Liquids, Corrosive, N.O.S.
Poisonous Liquids, Flammable, N.O.S.
Poisonous Solids, Flammable, N.O.S.
Potassium Cyanide
Strychnine
Tear Gas Substances, N.O.S., Liquid
Thiphosgene
Xylyl Bromide

SCHEDULE XII - PART II - CLASS 8 - CORROSIVE SUBSTANCES

Antimony Pentafluoride
Bromine
Chlorosulphonic Acid
Corrosive Liquids, Poisonous, N.O.S.
Dichloroacetyl Chloride
Etching Acid, Liquid, N.O.S.
Fumaryl Chloride
Hydrochloric Acid Solution or Hydrochloric Acid
Hydrofluoric Acid and Sulphuric Acid Mixtures
Nitrating Acid Mixtures, Spent
Nitric Acid, Fuming
Nitric Acid
Nitrohydrochloric Acid
Nitrosylsulphuric Acid
Sulphur Trioxide, Inhibited
Sulphuric Acid, Fuming or Oleum
Sulphuric Acid

APPENDIX I-2

NATIONAL ANALYSIS OF TRENDS IN EMERGENCIES SYSTEM
150 MOST FREQUENTLY SPILLED SUBSTANCES

APPENDIX I-2 150 MOST FREQUENTLY SPILLED SUBSTANCES

Acetic Acid
Acetic Anhydride
Acetone
Acetylene
Acrylonitrile
Adipic Acid
Aluminum Chloride
Aluminum Hydroxide
Aluminum Sulphate
Aminocarb Pesticide (Matacil)
Ammonia
Ammonium Chloride
Ammonium Nitrate
Ammonium Phosphates
Ammonium Sulphate
Arsine
Barium Sulphate
Benzene
Benzoic Acid
Borax
Boric Acid
Butanols
Butylene
Butyraldehydes
Calcium Carbide
Calcium Carbonate
Calcium Chloride
Calcium Hypochlorite
Calcium Oxide/Hydroxide
Calcium Phosphate
Caprolactam
Carbaryl
Carbofuran Pesticides
Carbon Dioxide
Carbon Disulphide
Carbon Tetrachloride
Chloradane
Chloride
Chloroform
Copper Sulphate
Cresols
Cyclohexane
Dicamba
Dichlorobenzene
Dimethyl Ether
Dimethyl Terephthalate
Dinoseb
Diphenylmethene-4,4'-Diisocyanate
Ethanolamine
Ethanol
Ethylbenzene
Ethylene
Ethylene Dibromide
Ethylene Dichloride (1,2-Dichloroethane)
Ethylene Glycol
Ethylene Oxide
Fenitrothion
Ferric Chloride
Fluorochloromethanes
Formaldehyde
Formic Acid
Hydrazine
Hydrogen Chloride/Acid
Hydrogen Fluoride/Acid
Hydrogen Peroxide
Hydrogen Sulphide
Hydrogen
Isopropanol
Isopropylbenzene
Latex
Lead Chromate
Lead Oxides
Magnesium Hydroxide
Malathion
MCPA
Mercury
Methanol
Methyl Ethyl Ketone
Methyl Isobutyl Ketone
Methyl Mathacrylate
Methylamines
Methylene Chloride
Morpholine
Naphta
Natural Gas
Nitric Acid
Nitrilotriacetic Acid
Nitroglycerine
Nonyl Phenol
n-Hexane
PCBs
Pentachlorophenol
Pentaerythritol
Perchloroethylene
Phenol
Phosphoric Acid
Phosphorous
Phthalic Anhydride
Potash (Potassium Chloride)
Potassium Hydroxide

APPENDIX I-2 150 MOST FREQUENTLY SPILLED SUBSTANCES (CONT'D)

Potassium Sulphate
Propylene
Propylene Glycols
Propylene Oxide
Sodium Aluminate
Sodium Arsenite
Sodium Borohydride
Sodium Carbonate
Sodium Chlorate
Sodium Chloride
Sodium Cyanide
Sodium Dichloroisocyanurate
Sodium Dichromate
Sodium Hydrosulphite (Dithionite)
Sodium Hydroxide
Sodium Hypochlorite
Sodium Phosphates
Sodium Silicates
Sodium Sulphate
Sodium Sulfite
Styrene (Monomer)
Sulphur
Sulphur Dioxide
Sulphuric Acid (and Oleum)
Sulphuryl Chloride
Tall Oil
Terephthalic Acid
Terphenyls
Tetraethyl Lead
Titanium Dioxide
Toluene
Triallate Pesticides
Trichlorfon Pesticides
Trifluralin Pesticides
Trinitrotoluene
Turpentine
Urea
Vinyl Acetate
Vinyl Chloride
Xylenes
Yellow Cake
Zinc Chloride
Zinc Oxide
Zinc Sulphate
1,1,1-Trichlorcathylene
1,3-Butadiene
2,4-D (2,4-Dichlorophenoxyacetic Acid)
2,4-Toluene Diisocyanate

APPENDIX I-3

CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON HISTORICAL SPILL DATA

APPENDIX I-3 CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON HISTORICAL SPILL DATA

2.1 Gases ignitable at normal atmosphere when in a mixture of less than 13% (vol.) with air or have a flammability range of at least 12, e.g.:

Hydrogen Sulphide, Liquefied or Hydrogen Sulphide
Methane, Refrigerated Liquid or Natural Gas, Refrigerated Liquid
Propane
Butane or Butanes mixtures
Ethylene, Compressed or Ethylene
Ethylene, Refrigerated liquid
Hydrogen, Compressed or Hydrogen
Hydrogen, Refrigerated Liquid or Hydrogen, Liquefied
Propylene
Vinyl Chloride, Inhibited
Butylenes
Ethylene Oxide
Butadiene, Inhibited
Acetylene, Dissolved or Acetylene
Ethyl Chloride

2.3 Gases have a LC_{50} of less than 5000 mL/m^3 at normal atmosphere by reason of toxicity, e.g.:

Arsine
Sulphur Dioxide, Liquefied or Sulphur Dioxide

2.4 Gases have a LC_{50} of less than 5000 mL/m^3 at normal atmosphere by reason of corrosion effects, e.g.:

Ammonia, Anhydrous, Liquefied
Chlorine
Hydrogen Chloride, Anhydrous
Hydrogen Chloride, Refrigerated Liquid
Hydrogen Fluoride, Anhydrous

3.1 Flammable liquids with a flash point of less than -18°C, e.g.:

Propylene Oxide
Carbon Disulphide or Carbon Bisulphide

4.2 Solids liable to spontaneous combustion, e.g.:

Phosphorus White, Molten
Phosphorus, White or Yellow, Dry or Under Water or In Solution

4.3 Substances that on contact with water emit flammable gases, e.g.:

Calcium Carbide

APPENDIX I-3 CHEMICALS WITH HIGH PROBABILITY OF RELEASE BASED ON HISTORICAL SPILL DATA (CONT'D)

5.1 Oxidizing substances, e.g.:

Hydrogen Peroxide, Aqueous Solutions
Hydrogen Peroxide, Stabilized

6.1 Poisonous/Toxic Substances with

LD_{50} (oral) < 5 mg/kg, or

LD_{50} (dermal) < 40 mg/kg, or

LD_{50} (inhalation) <500 mg/kg

e.g, Sodium Cyanide

APPENDIX I-4

SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Ammonia	Colourless gas.	Produced at 12 plants (7 in Alberta, 3 in Ontario and 1 each in B.C. and Manitoba); total annual production 2.5×10^6 t (1982).	Used widely across Canada for fertilizer manufacture or directly as fertilizer and in the production of certain chemicals, e.g., nitric acid, nylon, ammonium compounds; also used in the mining, pulp & paper and refining industries.	Shipped in tank cars as anhydrous ammonia (liquidified gas) or solution by rail or trucks.	Toxic by inhalation (TLV: 25 ppm), rapidly disperse in air and water; harmful to aquatic life in very low concentrations.	High production volume (top 3), spilled frequently (top 10), widely used, universally transport and toxic.
Ammonium nitrate	White to light gray solid granules.	Produced at 11 plants in Alberta, Ontario, Quebec and Manitoba; total annual production 1.2×10^6 t (1982).	Used as fertilizer and explosives across Canada.	Shipped across Canada by trucks and by train (box cars).	High explosion potential.	High production volume (top 5), transport universally with explosion potential.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Chlorine	Greenish yellow gas	Produced at 13 plants across Canada (all provinces except Manitoba, PEI and Newfoundland); total annual production 1.4×10^6 t (1984).	Used widely across Canada mainly by pulp & paper, mining & smelting and water treatment industries as well as starting material for the manufacture of certain chemicals.	Shipped in tank cars as liquidified compressed gas by rail or trucks.	Highly toxic (based on its corrosive properties) to human via all routes (TLV: 1 ppm) as well as to all form of aquatic life (TL_m96 less than 1 mg/L), plants and animals; highly reactive, reacted with water to form HCl gas which is also toxic (TLV: 5 ppm).	High production volume (Top 9), spilled frequently (Top 10), widely used, universally transport and and highly toxic.
Ethylene	Colourless gas.	Produced at 5 plants in Ontario (Sarnia), Alberta (Joffre) and Quebec (Montreal); total annual production 1.01×10^6 t (1982).	Used in the manufacture of polyethylene, ethylene oxide, ethylene dichloride and ethylbenzene located near the production sites.	Shipped primarily via pipeline directly to users; some product in Sarnia is shipped in tank trucks to the U.S.	Extremely flammable with explosion potential; harmful to sensitive plants at concentration in excess of 0.1 ppm.	High products volume (Top 5), spilled frequently (Top 50) and extremely flammable.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Hydrogen chloride	Colourless gas: aqueous phase is anhydrous hydrochloric acid (pale yellow liquid).	Produced at 13 plants across Canada (all provinces except PEI, Manitoba amd Newfound-land); total annual produc-tion 135 kt (1982).	Used widely across Canada mainly in the electronic, petroleum, steel and metal working industries; also used for brine purifica-tion in mining, metallurgical, and pharmaceutical industries as well as raw material for manufacture of certain chemicals.	Shipped in tank cars as aqueous hydrochloric acid by rail or trucks.	Toxic by all routes (TLV: 25 ppm); highly corrosive to living tissues. Harmful to aquatic life in low con-centration (due to its acidity).	Widely used, trans-port universally, spilled frequently (top 50) and highly corrosive.
Hydrogen fluoride	Colourless gas; aqueous phase is anhydrous hydrofluoric acid (water-while liquid).	Produced in Quebec and Ontario; total annual produc-tion 79 kt (1982).	Used mainly in Ontario and Quebec in the production of certain chemicals, i.e., aluminum fluoride, uranium hexfluoride, and motor gasoline alkylate; a small amount is transported to B.C. and Alberta.	Shipped as a liquidified gas in tank car primarily by rail.	Highly toxic by inhalation, ingestion and skin absorption (TLV: 3 ppm) Harmful to aquatic life in very low concentration.	Spilled frequently (Top 50) and highly toxic.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Hydrogen sulphide	Colourless gas with rotten egg odour.	Produced at 4 plants in Alberta, Ontario and Quebec; total annual production 11.9 kt (1980).	Used mainly in the manufacture of heavy water, elemental sulphur and certain chemicals e.g., soda ash, sodium hydrosulphide, mercaptans, nylon, ethylene, etc.	Shipped in railway tank cars and cylinders to areas across Canada.	Highly toxic by inhalation and contact (TLV: 10 ppm); toxic to aquatic life at very low concentrations; flammable.	Transport universally, spilled frequently (top 50) and highly toxic.
Natural gas	Colourless and odourless gas; consumer gas has an odourant added.	Produced over 3500 wells, most of them in Alberta (86%), the others are in B.C. (12%), Saskatchewan, Ontario and NWT; total Canadian production 480 x 10^6 cm^3/d (1983).	Used widely across Canada for heating and in the manufacture of petrochemicals.	Transported by pipeline across and throughout Canada.	Highly flammable with explosion potential.	High production volume, widely used, transported across Canada, Spilled frequently (top 5) and flammable with explosion potential.

APPENDIX I-4 SUMMARY OF TECHNICAL INFORMATION FOR SELECTED CHEMICALS (CONT'D)

Name of Chemical	Physical State	Production	Uses	Transport	Hazards	Remarks
Phosphorus	Colourless or white to pale yellow solid.	Produced at 2 plants is Newfoundland and Quebec; total annual production 55 kt (65% of the total production was exported).	Used mainly to produce phosphoric acid; a few percent was used to produce chemicals, such as red phosphorus, phosphine and phosphorus sesquisulphide.	Shipped in liquid state under a water cover in railway tank cars or tank trucks in Quebec and Ontario.	Highly toxic by all routes (TLV: 0.1 mg/m^3); toxic to aquatic life in very low concentrations; ignites spontaneously to produce highly toxic gases.	Highly toxic with potential to ignite spontanously and produce highly toxic gases.
Sulphur	Yellow powder granules, lumps or prills; in mollen form is yellow to orange-red.	Produced across Canada (in all provinces except PEI); total annual production 6.67×10^6 t (Alberta accounts for 90%).	Used widely across Canada mainly to produce sulphuric acid (3/4 of the total production) and by the pulp and paper industry.	Shipped in either solid or molten form all over Canada.	Combustile to produce toxic sulphur dioxide gas; reacts violently in contact with oxidizing agents; molten sulphur may evolve toxic hydrogen sulphide gas.	High production volume, used widely, transport universally and may react with others to produce toxic gas or with explosion potential.

PART II

PREVENTION

Report of Working Group 2

A Review of Measures Taken by Industry and Government to Prevent Major Industrial Incidents in Canada

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The Chairmen of the other two Working Groups act as observers for this group.

SUMMARY

The objective of Working Group 2 was to assess the existing measures taken by industry and governments to prevent Bhopal-like incidents.

Legislation at the three levels of government can generally be described as:

- zoning and land-use planning (municipal/provincial);
- plant design approvals, safety and occupational health, environment (provincial/federal); and
- transportation (federal/provincial).

In designing and operating their production facilities, major industries have relied on their own standards to increase safety margins in addition to regulatory requirements. The Canadian Chemical Producers' Association's (CCPA) review of the practices of its member companies after Bhopal, indicates that most companies have established safety audit programs. The approach to these audits is variable and so CCPA has introduced a minimum standard safety audit procedure. The Working Group recommends that these procedures be implemented at plants which are outside of the CCPA membership but manufacture or use hazardous materials.

Effective safety management programs must start with the commitment of the senior officer of the company and be communicated through all levels of company personnel. Line supervisors and employees alike must be held accountable for safe operation. Again the Working Group believes that the safety philosophies and programs of the larger companies have to be incorporated into the operating practices of the medium and smaller operators.

Implementation of the Transport of Dangerous Goods Regulations accompanied by the improvements made in the rail system following the Mississauga derailment should reduce the number and size of transportation incidents. In the same way that Lodgepole affected the sour gas industry, Bhopal is causing considerable reaction in the chemical industry in the areas of improved safety practices and community awareness.

Even with all of these programs in place, there are still no guarantees that such accidents will be eliminated and emergency response plans must therefore be built into each program.

1 INTRODUCTION

This report provides an assessment of the measures taken in Canada by industry and government to prevent Bhopal-type incidents.

Working Group No. 2 was given the following terms of reference:

1) to undertake a review of existing legislation regarding zoning (or siting), design and construction of production facilities, process safety, in-plant storage and distribution/transportation of hazardous chemicals including petroleum products;
2) to identify the measures taken by industry and government to plan for and achieve safe handling of chemicals throughout the design and construction of manufacturing facilities, production, storage, distribution, transportation and use (especially major bulk users);
3) to examine initiatives taken by industry to encourage management responsibility for accident prevention such as regular internal safety audits; and
4) to make recommendations as appropriate.

The primary focus of this report is on major chemical accidents as defined by the Steering Committee and used by Working Groups 1 and 3.

Working Group 2 is made up of representatives of industry and a number of government departments. To obtain a wider information base:

- provincial input was sought through the Federal/Provincial Adivisory Committee on Occupational and Environmental Health and the Federal/Provincial Committee on Occupational Health and Safety Canadian Association;
- direct input was sought also from groups such as the Industrial Accident Prevention Association of Ontario, and the Federation of Canadian Municipalities; and
- public input was provided through a number of public interest group organizations among them, "Friends of the Earth" and the "Canadian Environmental Law Association".

While accident prevention is the main theme of this report, its scope includes:

1) an examination of accident prevention legislation in Canada;
2) a review of industry and government accident prevention programs; and
3) a discussion of the importance of community and worker awareness.

2 LEGISLATION FOR ACCIDENT PREVENTION

In Canada, legislation relating to the life-cycle of chemical production from siting and zoning, through design, construction and operation, to transportation and distribution generally parallels the hierarchy of government levels from municipal through provincial to federal. The three levels of government have a shared responsibility for controlling major industrial incidents, each with different degrees of legislative authority. As a rule, municipal governments are involved in setting by-laws regarding the location of plants in order to provide adequate buffer zones between industrial complexes and residential areas. Plant design and construction approvals in regard to occupational health and safety and environmental concerns lie for the most part within provincial jurisdiction. At the federal level, emphasis is placed on the various modes of transport and consumer safety.

The following sections provide an overview of existing legislation affecting accident prevention and offering protection from major accidents.

2.1 Municipal

As mentioned earlier the prevention of major industrial incidents such as Bhopal, is controlled to some degree by existing provincial and municipal statutes. At the municipal level this usually takes the form of zoning by-laws which are administered by local planning and development departments.

In Canada the municipalities are the creations of the provinces and their legislative authorities are granted under municipal acts and/or planning acts. Under such legislation the municipalities are given primary responsibility for local land-use planning. By insisting on adequate buffering distance between heavy industrial sites and residential areas the impacts of major environmental upsets can be mitigated.

The provincial agencies have developed land-use compatibility guidelines recommending separation distances and other control measures to protect citizens from unwanted emissions. The objective of such guidelines is to minimize the exposure of humans to adverse environmental impacts and nuisance factors. In addition, certain provinces have delegated responsibility for atmospheric emission controls to large metropolitan areas e.g., the Greater Vancouver Regional District (GVRD) and the Montreal Urban Community (MUC). Industry in these areas must conform to federal, provincial and community standards.

Community land-use planning helps to minimize the impact of major disasters involving industrial facilities. Where communities have grown up around industrial sites, buffering is generally minimal and emphasis must be placed on in-plant safety programs.

Such is the case in many areas of the country. In the upstream oil and gas sector, there have been applications to drill sour gas wells in relatively close proximity to urban areas. Of course, all safety requirements and emergency response plans are thoroughly reviewed to meet the requirements (including zoning) of the Alberta Energy Resources Conservation Board.

The Working Group is aware of several cases where residential housing has been constructed adjacent to oil refineries. Two examples are the Shellburn refinery in Burnaby, B.C. and the now closed Texaco refinery in Port Credit, Ontario. In the last few years, two new refineries have been constructed well away from any residential areas; the Texaco refinery at Nanticoke, Ontario and Shell Scotford refinery at Fort Saskatchewan, Alberta. Proper zoning and land use planning principles were applied in both cases.

The chemical and manufacturing sectors have also experienced the problems of having residential areas built close to the plant. This is particularly in the pulp and paper industry where many mills are located virtually in the centre of town. Such is the case at Fort Frances, Ontario where a chlorine leak in November, 1984 forced an evacuation and had the potential for impact on the local hospital.

There are also examples of many good practices which have been in place for quite a few years. Some include the Dupont and Nitrochem facilities located outside of Maitland, the Dow phenol plant (now Chatterton Chemical) at Tilbury Island outside of Vancouver and the Varennes area southeast of Montreal.

It is extremely difficult for municipalities to control residential encroachment into industrial basins. More senior governments can perhaps assist in this area by providing guidance and resources to local governments.

2.2 Provincial

Safety in industrial plants is an important consideration when chemical, petroleum and natural gas plants and related storage facilities are being designed and built, and when process operations are being planned. The training of workers in proper work procedures is an important feature of safety programs.

Occupational safety legislation and regulations were first proclaimed by each of the provinces/territories and by the federal government in Canada. For a long time, each of these jurisdictions has had a regulatory agency for monitoring and, where

necessary, for enforcing its regulations. Occupational safety and health regulatory agencies have cooperated as members of the Canadian Association of Administrators of Labour Legislation (CAALL) since the early 1960's.

In Canada, industrial safety regulations are aimed at protecting the health and safety of workers. The prime responsibility of employers to manage their business effectively is recognized in addition to the rights and responsibilities of workers. Safety is perceived as everyone's business. Workers must report unsafe working conditions to their supervisors who in turn must respond to the workers' concern. Employers are required to inform their employees about potential hazards and workers have a right to know about the risks they face at work. Workers also have the right to refuse to work in conditions which are unsafe, and employers have a responsibility to correct unsafe conditions. Such measures may include engineering controls, safe work procedures or other measures to reduce the possibility of accidents. At a worksite, workers must follow plant safety rules which are enforced by their employers. In potentially hazardous estabishments which have 20 or more workers joint health and safety committees are required. Such committees are expected to inspect for unsafe conditions, to consider the adequacy of worker training and to recommend improvements where needed or feasible. Safety and accident prevention are synonymous and largely a matter of attitude to be fostered by management, labour and government.

Preventive measures must be taken when potential hazards are identified during design and construction of industrial plants, during worksite safety audits, or as a result of the investigation of an accident in the workplace. Major accidents involving loss of life, serious injuries, or significant property loss or damage must be investigated to identify and correct causes of the accident. Consensus standards for preventive measures are frequently referenced in safety regulations. Such standards are amended from time to time as a result of experience gained from mishaps in Canada as well as in other countries.

Accident prevention programs in different chemical or petroleum manufacturing plants may be similar in concept but are usually different in detail. They are worksite specific and involve engineering controls, proper work procedures and worker training and education. While such programs are considered important in protecting the health and safety of workers, they are also important means of preventing fires, explosions and releases of toxic gases which threaten the health and safety of the public in nearby communities and may place the ecological environment at risk as well.

Both employers and workers in hazardous industries must be aware of possible risks and the importance of preventing accidents. Compliance with occupational safety and health regulations ensures a minimum standard of performance to control the possibility of injuries to workers. At the same time, it determines an acceptable level of safety attitude in a plant. Regulations complement performance standards which industries have evolved over time. It is generally accepted that effective plant operations over a long-term period can be achieved only when all risks are effectively controlled.

Some of the specific considerations covered by current occupational health and safety regulations include confined space entry, fire and explosion prevention, piping systems safety, approval of plans, drawings and specifications for new buildings or alterations to existing buildings including industrial plants, material handling, drilling and drill stem testing for petroleum and natural gas production plant operation. The following are examples of current safety legislation and regulations. The examples chosen deal with boilers and pressure vessels, piping and tank system safety, as regulated by federal, provincial and territorial jurisdictions.

1) Boilers and Pressure Vessels. A large number of statutes covering hazardous equipment and installations which are regulated in each jurisdiction with respect to concern for worker and public safety can be listed under the general heading of special legislative provisions relating to certain installations and industries in federal, provincial and territorial jurisdictions in Canada. Boilers and pressure vessels, gas and oil burning equipment, elevators and lifts and electrical installations are among these. The acts are administered by different departments depending on the jurisdiction. It is frequently a department or ministry of labour and manpower, a ministry of consumer affairs or some other, that is responsible for enforcement. In each instance, on site inspections are carried out periodically to ensure proper design, use, operation and maintenance of boilers and pressure vessels, etc.

2) Piping Systems. Piping systems and tanks are also included in the Canada Dangerous Substances Regulations. Employers are required to ensure that every piping system or tank is adequate for its intended purpose with regard to corrosiveness, pressure, temperature and any other hazardous properties of the materials they contain. Pipelines must be fitted with control devices to ensure safe operation, maintenance and repair. Each person who operates, maintains or repairs any part of a piping system must know the location and use of every valve in the system.

3) Tank Systems. Maintenance and repair of tanks are regulated under "working in confined spaces" of the Occupational Safety and Health regulations. Most jurisdictions in Canada deal with the hazards of confined spaces. These require that piping systems be blanked off during repairs and means of doing so must be available. For example, the Canada "Confined Spaces Regulations" requires that the flow of any substnace to or from a confined space be prevented by means of a solid plate that completely blocks such material and that it is not dependent for its effectiveness on a valve or similar device. Alberta regulations contain similar requirements. Newfoundland, Saskatchewan, Ontario and New Brunswick each have general regulations for piping systems and tanks and have required blanking off under their Boiler and Pressure Vessel acts. British Columbia and the Northwest Territories require that pipelines be blanked off during repairs to piping systems. Tanks and pipelines must also be fitted with restraining devices and identified in accordance with the American National Standards Institute (ANSI) "Scheme for the Identification of Piping Systems" - A.13.1. Nova Scotia and Prince Edward Island have provided guidelines for pipelines in connection with the storage of hazardous liquids in tanks. A list of current Federal and Provincial Occupational Health, Safety and Related Environmental Legislation is outlined in Appendix II-1.

The use of the National Standards System of Canada in regulating occupational safety, provides additional means of preventing accidents involving hazardous chemical and petroleum products. These include standards produced by the Canadian Standards Association (CSA), the Bureau de normalisation du Québec (BNQ), Underwriters' Laboratories of Canada (ULC) and the Canadian Gas Association (CGA).

Provincial safety legislation sets base line standards in the workplace to prevent injuries and loss of life. Proper in-plant safety practices minimize the risk of large-scale community incidents and are an important part of the community safety program.

2.3 Federal

Federal legislation mainly covers the transport sector of the industrial accident problem. Of course, federal legislation in safety practices parallels provincial legislation pertaining to boiler and pressure vessels, confined entry, personal protective equipment, etc., for those activities related to its own jurisdiction.

As mentioned in Part I, Agriculture Canada legislates pesticides manufacture under the Pest Control Products Act. Specific requirements relate to safety and provision for a plant inspection program exists.

As shipment of goods is often transboundary, the federal government has always maintained the lead jurisdiction. As railway, roads and water systems were developed, relevant laws and regulations were implemented as necessary. Such legislation includes the Railways Act, Aeronautics Act, and the Canada Shipping Act which are administered by the Canadian Transport Commission and the Canadian Coast Guard. Under these acts, there are many regulations which apply to safety.

Starting around 1975, Transport Canada and other agencies began to look at the transport of hazardous materials in all four modes. On November 10, 1979 one of the worst Canadian derailment accidents took place in Mississauga, Ontario which resulted in the evacuation some 216 000 people. This event launched a public enquiry and led to the federal government accelerating the development of legislation pertaining to the transport of hazardous commodities.

In 1980 the federal government passed into legislation the Transportation of Dangerous Goods Act (TDGA). This act is intended to promote public safety in the transportation of dangerous commodities including chemicals. It applies with specific exceptions, to all handling, offering for transport and actual carrying of dangerous goods through Canada irrespective of their point of origin or destination or the means of conveyance.

In July 1985, the first regulations under TDGA came into force and applied to all modes of transportation. They respected the handling, offering for transport, and transport of dangerous goods as follows:

Road - Prior to these regulations, virtually no road regulations existed. The design specifications for tanks are identical with those of the United States Department of Transport as given in 49 CFR (Code of Federal Regulations Title 49).

Rail - The transportation of dangerous goods by rail has for many years been regulated under the Canadian Transport Commission's Regulations for the Transportation of Dangerous Commodities by Rail. As of July 1, 1985 these regulations must conform to the TDGR in respect of documentation, marking and placarding for packaged dangerous goods. CTC retains responsibility for bulk movements and operational matters such as speed, segregation and tank car specifications (the latter are essentially the same as United States Department of Transport specifications).

Air - Aeronautics Act/ICAO for international shipments by air (International Civil Aviation Organization).

Sea - Canada Shipping Act/IMDG Code for international shipments (International Maritime Dangerous Goods Code).

Storage - The Transportation of Dangerous Goods Act covers in-transit storage. The existing regulations do not specify requirements for in-transit storage of chemicals and are being reviewed.

Specific actions under TDG Regulations will improve safety and prevent accidents. These are:

a) requiring adequate documentation of risk;
b) requiring that packages be marked, labelled and placarded with an indication of risk;
c) requiring minimum package specifications;
d) requiring that dangerous goods be suitably segregated from each other and safely stowed;
e) requiring that personnel involved with dangerous goods be appropriately trained; and
f) requiring the appointment of regional inspectors of dangerous goods (eleven such inspectors are currently in place).

TDG Regulations will be implemented through provincial programs in departments such as Environment and public safety agencies. Some Canadian municipalities have required special routing for dangerous goods traffic (e.g., Edmonton). This is an issue that has been in the legislative force in many U.S. cities and will no doubt be picked up across Canada.

Vehicle inspection with respect to brakes, tires, load distribution and method of retention of load will help reduce the likelihood of an accident. Too much outage in tankers and tank containers can result in instability and turnover even at low speeds. Although the level of filling is not specifically addressed in the Regulations, it is something that must be considered and be subject to inspection.

Tunnels respresent a very real danger when transporting dangerous goods as evidenced by some serious disasters. Bridges also present an additional risk. Rules for tunnels and bridges already exist in the United States and Europe. A general review of actions pertaining to tunnels and bridges in Canada is underway by Transport Canada.

The Mississauga accident would not have been prevented by any dangerous goods regulations as the cause was related to a malfunction in railway equipment. The

Working Group can only conclude that the regulatory side of the issue has been addressed. Nonetheless, there is still room for senior governments to assist municipalities in designating traffic routes for the dangerous commodities which pass through their boundaries. Transport regulations will help reduce the impact of such occurrences by:

a) allowing the ready identification of the hazard;
b) segregating incompatible substances;
c) setting safety standards for packaging; and
d) improving emergency response.

3 MANAGEMENT OF SAFETY AND LOSS PREVENTION

Industry has the main responsibility for health and safety of its operations. The safety programs of the major chemical and petroleum plants in Canada cover a wide spectrum of activities and all of these companies employ full time staff whose primary function is to maintain and improve safety.

3.1 Corporate Commitment

In Canada, legislation clearly defines the responsibility of the employer for safety. Most company presidents in the Chemical and Petroleum Industry have taken this responsibility seriously and have communicated this commitment to safety throughout their organizations. Each safety program starts with a policy statement, which is usually signed by the Chief Executive Officer of the company, clearly stating that the objectives of the company must be the total elimination of accidents, injuries, or losses to the employees, the company, the public and the environment.

The Chief Executive Officer's commitment alone, will accomplish little unless it is converted into specific activities. The most effective way used to ensure that safety becomes part of the company's culture is by making safety a line responsibility and providing line management with safety professionals as resource persons. Merely stating that safety is a line manager's responsibility is not particularly effective. In many cases his performance in that area is appraised on a regular basis and his safety performance is directly related to promotion and pay. When operational safety is treated as a normal part of routine operations, losses can and will be minimized.

A typical policy statement used by a major manufacturer of chemicals in Canada is:

> "Concern for the safety and health of our people is fundamental to the manner in which we conduct our business. Our objective in safety and loss prevention is the elimination of injuries and losses."
>
> Management is responsible for:
>
> (1) Creating an awareness and understanding of our objectives.
>
> (2) Establishing the necessary training programs so that we understand how to do our business safely.
>
> (3) Monitoring our performance to ensure that we are making progress toward our objectives.

> To fulfill our duties as employees, we must recognize that we share the responsibility for loss prevention, our own safety, and the safety of our co-workers." (Dow Chemical Canada Inc., 1983).

3.2 Responsible Care Programs

The Canadian Chemical Producers' Association (CCPA), a voluntary trade association made up of some 65 member companies representing the major chemical manufacturers in Canada, has for some time recognized its social mandate with regard to health and safety and has developed a policy of "Responsible Care" that is now a condition of membership. "Responsible Care" involves encouraging the responsible development, introduction, manufacture, transportation, storage, handling, distribution, use and ultimate disposal of chemicals and products so as to minimize adverse effects on human health and the environment.

Principles incorporated into the policy and subscribed to by CCPA members are:

- to ensure that operations do not present an unacceptable level of risk to employees, customers, the public or the environment;
- to provide relevant information on the hazards of chemicals to customers, urging them to use and dispose of products in a safe manner; and make such information available to the public on request;
- to make responsible care an early and integral part of the planning process leading to new products, processes or plants;
- to increase the emphasis on the understanding of existing products and their uses and ensure that a high level of understanding of new products and their potential hazards is achieved prior to and throughout commercial development;
- to comply with all legal requirements which affect its operations and products;
- to be responsive and sensitive to legitimate community concerns; and
- to work actively with and assist governments and selected organizations to foster and encourage equitable and attainable standards.

3.3 Training

It is management's responsibility to see that people are trained to do the job properly, paying attention to details in meeting their job objectives. In other words, a job done properly is done safely.

Senior line management at a plant location communicates down through the hierarchy to the first line supervisors who in turn train each and every employee on how

to carry out his/her function in a safe manner. The employee must not only understand the company safety policies, but he/she also must be trained how to detect hazards, to investigate accidents and to respond to emergency situations.

Safety professionals assist senior management by designing training programs that will not only inform but also motivate the workers to continually perform safely during their activities. Safe procedures for plant operations including start-up and shut-downs of units must be communicated in all the varied details to the plant personnel responsible for their execution.

In the chemical and petroleum industries employees are trained in mandatory Safety and Health standards relative to their functions. An inventory of critical skills/knowledge relative to the position is compiled. Initial training in those mandatory procedures is required before the employee is allowed on the job. Mandatory re-qualification is required after a certain time interval. Qualification of the procedure is achieved through written quizzes (not true or false) and field testing. An example of a training matrix is included in Appendix II-2.

In addition, accident reports and reports of near misses should be given wide company circulation and existing procedures evaluated in terms of the new experience. It is management's function to insure that the neverending cycle of evaluation, training and re-evaluation of plant practices is an on-going activity.

The objective of this type of training is to allow company personnel to be aware and identify hazards and reduce the risk of accidents.

A number of companies, notably the J.T. Baker Company have, for some time, organized seminars in various parts of Canada on aspects of safety in the workplace. The advertisement for the most recent series of two day seminars (August, 1985) covers the subjects "Hazardous Chemicals Safety", "Hazardous Spill Response" and "Management as a Safety Training Tool" (J.T. Baker Chemical Co., 1985).

Several community colleges offer safety courses. For example, the College of Cape Breton (Cape Breton, Nova Scotia) runs an annual safety course with the assistance of the department of Environmental Health and Safety, Industrial Hygiene, Harvard University. The Industrial Association for Prevention of Accidents (IAPA) in Ontario has initiated certain training programs in high schools. The general lack of safety programs and formal instruction in schools and universities, however, is of serious shortcoming.

Training programs in smaller companies are more likely to be served by safety organization such as IAPA (Ontario), labour organization and safety consultants. The adequacy of these programs for providing training to prevent Bhopal-type incidents was

not thoroughly investigated by the Working Group. There is a need in Canada for training institutions to provide adequate in-depth safety courses.

3.4 Auditing

Safety auditing is viewed by many experts in the field as one of the most important features of a comprehensive safety and loss control program. It represents an independent evaluation of a company's or operating location's safety program. As such, it examines the adequacy of the program and how well it is followed. Properly planned and executed audits will identify program deficiencies and measure deviation from normative standards of performance.

Chemical and petroleum companies employ a variety of auditing options which include:

1) Internal Auditing - local management and the Health and Safety Committee, at the location may carry out periodic safety audits.
2) Company Audits of an Operating Location - usually conducted by Head Office specialists and personnel from other plant locations.
3) Insurance Company Audits - where insurance company trained risk assessors review the operating location for such factors as:
   - fire protection;
   - process safety;
   - pressure vessels integrity (both fired and unfired); and
   - electrical code compliance.
4) Government Inspection - Occupational Health and Safety or environmental agencies conduct periodic inplant compliance audits.
5) Industry Associations - Industry Associations such as the Canadian Chemical Producers' Association have developed safety assessment programs to assist member companies (Appendix II-3).
6) Safety Associations - Organizations such as the Industrial Accident Prevention Association of Ontario have made the "5 Star Safety Audit Program" available to interested parties (Appendix II-4).

Chemical and Petroleum facilities, in addition to frequent internal audits by location personnel, should also be subjected to periodic external audits. This audit should be conducted by people outside of the location or company, but familiar with the type of operation involved. Such an audit would last up to a week and involve a team approach.

Accountability for action to correct any deficiencies found in these audits is left to the line organization.

The Industrial Accident Prevention Association provided information to the study indicating that some one hundred firms in Ontario are involved with the "Five-Star" safety audit program and that twenty-four of these firms are from the petroleum and chemical sectors.

4 ACCIDENT PREVENTION MEASURES

This section deals with the specific safety and loss control programs of industry in the areas of design, construction, operation of plant, storage and distribution facilities as well as government programs related to transportation and workplace safety.

4.1 Industry

4.1.1 Engineering Design and Construction. In the design of chemical and related industrial plants, standard chemical, mechanical, civil and electrical engineering concepts are employed by registered professionals which ensures that an acceptable standard of safety is "built in". This approach to design is complex in nature and over the years has become technically very sophisticated. In recent years the field has been expanded to include specialization fields such as environmental sciences, toxicology, occupational medicine, industrial hygiene and safety.

The design of new facilities and major modifications to existing plants are subject to Environmental, Health and Safety reviews at all stages of the project, including pre-project environmental impact assessments and pre-start-up safety reviews. A list of topics covered during the project review stages is shown in Table 1. Typical examples of this review process are presented in Appendix II-5.

A recent publication by The Chemical Manufacturers' Association (May 1985) entitled "Process Safety Management" presents a systematic approach to evaluating and controlling hazards during the design and pre-operating phases of a project. Such hazard and operability (HAZOP) studies are applied to new designs to assess the hazard potential for "mal-operation" of individual pieces of equipment and the consequences of such mal-operation on the total facility. These studies not only assist in selecting optimal equipment systems, but also lead to minimizing hazards by reviewing alternative feedstock and process options.

More rigorous systematic approaches to hazard identification include techniques such as: fault tree analysis; cause-consequence diagrams; and event tree analysis. A schematic diagram showing the integration of hazard identification, assessment and control is shown in Figure 1.

4.1.2 Operations. Each plant facility, operating location or major function has as a minimum a written set of standard operating procedures to be followed. In addition, formal procedures for maintenance and control, inspection and testing, control of plant modification, security and emergency response plans are part of operations safety and loss

TABLE 1 CHECKLIST OF SUBJECTS COVERED DURING PROJECT REVIEW

Process Design

1. Alarm/Interlocks
2. Control System Reaction Time
3. Flow
4. Pressure
5. Temperature
6. Corrosion
7. Chemical Reaction
8. Electrical Classification
9. Emergency Conditions and Emergency Shutdown
10. Control System Sequence
11. Safety Relief Devices Capacity
12. Valve and Piping Specifications
13. Critical Instrument Control
14. Fire and Emergency Protection Systems

Maintenance/Operability

15. Physical Arrangement
16. Accessibility (platforms-ladders)
17. Required Safety Equipment
18. Piping Supports
19. Safety Valve Discharge Routing
20. Insulation
21. Handrails and Guards
22. Provisions for Isolation
23. Provisions for Cleanup
24. Pipe Stress
25. Vibration
26. Equipment and Line Labelling
27. Effects of Unchanged Facilities
28. Reliability
29. Spare Parts Availability

Personnel Safety

30. Gas Detection
31. Excessive Noise
32. Excessive Heat
33. Proper Ventilation
34. Lighting
35. Radiation Exposure
36. TLV Exposure
37. Protective Equipment and Procedures for Handling Chemicals

Environmental Concerns

38. Air Emissions
39. Water Effluent
40. Solid Waste Disposal

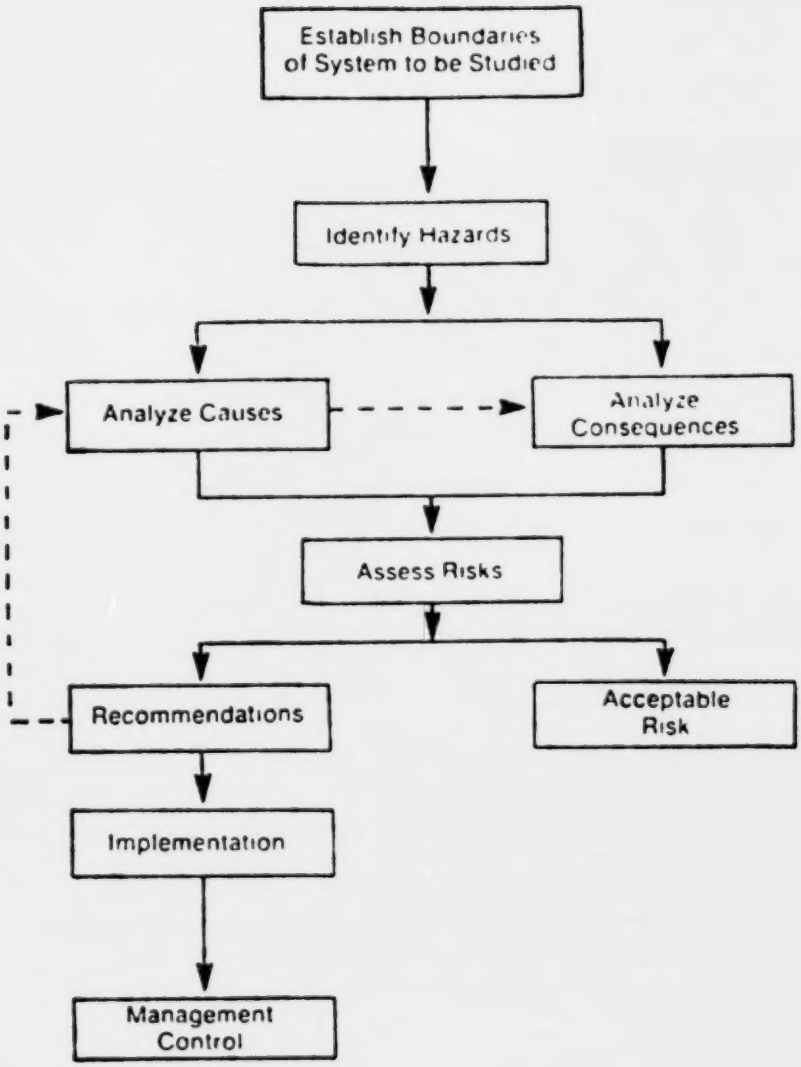

FIGURE 1 INTEGRATION OF HAZARD IDENTIFICATION, ASSESSMENT AND CONTROL (CMA, 1985)

control programs. In addition, operator training and periodic audits of process safety practices and operator and maintenance staff training are carried out by personnel external to the site.

Accidents or near misses are being investigated, analyzed and reported on a factual basis. The reports should be communicated widely and a sysetm for learning from other plant's experiences should be in place.

For a more detailed description of safety practices during the operating phase of the product cycle the reader is referred to the "Process Safety Management" publication (CMA, 1985).

4.1.3 Storage and Distribution. Storage and distribution facilities for chemical or petroleum products undergo the same scrutiny as petroleum refineries and chemical plants. Safety practices during design and operation follow the systematic reviews and audits.

Special emphasis in storage should be placed on minimizing quantities of hazardous materials stored not only as raw materials and finished products, but as chemical intermediates as well. Secondary containment facilities and techniques are employed in order to minimize potential atmospheric releases or accidental spills.

In terms of product distribution and transport, companies shipping hazardous commodities, in recent years, carry out inspections of tank trucks and railway tank cars to reduce the risk of accidental losses.

In the case of rail transport, undercarriage as well as tank vessel inspections are carried out both by the major chemical companies and the railway companies. Inspection for mechanical integrity are a requirement under the Canadian Transport Commission regulations.

Routing of hazardous chemical carriers is usually designed to minimize public exposure to hazards. In the transportation industry, traffic controls and communication systems have been modernized and in many cases computerized, to increase safety in areas of high population density and traffic.

4.1.4 Effectiveness of Industry Practices. As an indication of the effectiveness of industry's safety programs, Working Group 2 found a lack of good statistical data on hazardous chemical accidents. However, Statistics Canada has provided information on worker injuries by different industry sectors. The data listed in Table 2 show that the petroleum and chemical sectors had 25 to 50% fewer reported time loss injuries in 1982, than the industry average. This demonstrates that the safety practices in the industry are relatively effective in comparison to other major sectors.

TABLE 2 WORK RELATED INJURY FACTS - 1982 (all Provinces)

Industry Sector	Reported Time-Loss Injuries and Illnesses per 100 Workers
Manufacturing:	9.4
Primary Metal	8.7
Paper and Allied Products	7.1
Electrical Products	5.7
Petroleum and Coal Products	2.4
Chemical and Chemical Products	4.5
Construction	12.1
Transportation, Communications and Other Utilities	5.4

Note: These results are based on data provided by all provincial Workers' Compensation Boards and by Statistics Canada for the year 1982. Reported work related time-loss injuries and illnesses, and national employment statistics were used. Industry sectors shown are from the Standard Industrial Classification Code.

These incident rates (injuries and illness per 100 workers) reflect to some considerable extent the results of efforts by employers and employees to control the causes of industrial accidents. They are based on data collected from the Workers' Compensation Boards in each provincial jurisdiction, for the purpose of developing national work injury statistics covering all industries in Canada. The accuracy of the data available for the industry sectors shown was deemed to be sufficient to illustrate in a relative way, how average rates of accidental injuries in two potentially high risk industries compare to some other industries in Canada for the year 1982.

A time-loss injury or illness is reported when a worker is absent one or more days because of injury or illness due to work related causes such as on-the-job accidents and work hazards. It is generally accepted that such accidents are prevented and hazards controlled when employers and employees co-operate in effective accident prevention programs.

Safety statistics can be interpreted as an indication of the approach taken by a sector towards safety but not as a reflection of the programs in place to prevent a major incident.

4.2 Government

4.2.1 Workplace Hazardous Materials Information System (WHMIS). The importance of information about potential workplace safety and health hazards related to the production and use of chemicals and chemical products has been well recognized by industry, organized labour and federal-provincial occupational safety and health regulatory agencies. In 1982 a federal-provincial government task force proposed that hazardous materials should be required to be labelled for the workplace, that material safety data sheets (MSDS) should be provided for such materials, and that workers should be trained to work safely when using such materials.

The Workplace Hazardous Materials Information System (WHMIS) was then developed in consultation with industry and labour. In June 1985 the recommendations of the WHMIS Project Steering Committee were presented for consideration of senior authorities in all jurisdictions. As of November 1, 1985 approval in principle has been given by most and is expected from all jurisdictions. The task of drafting appropriate legislation and regulations which will allow WHMIS to function on a national basis and satisfy all parties concerned, remains to be done.

When WHMIS is implemented, domestic producers and importers of hazardous industrial materials will be required to evaluate and classify their products, and provide all pertinent available information by labelling containers and providing an MSDS for each product. Also, employers who are users of hazardous materials will be required to inform and train their workers, on the basis of the information provided, to work safely and be protected from possible harmful effects of exposure to these materials. Workers will be responsible for participating in these education programs and for using information gained on the job to protect themselves and their fellow workers.

Many petroleum and chemical companies have already developed material safety data sheets and are well advanced in employee training programs.

4.2.2 Transportation and Routing. The Canadian Transport Commission (CTC) has had on-going programs for many years in regard to rail safety. However, the Mississauga accident caused the Canadian Transport Commission and the transport industry to reevaluate certain measures particularly in regard to the recommendations of the Grange Commission (incl). A few of these modifications are:

- double-walled bulkheads on cars carrying hazardous liquids;
- improved insulation on bulk cars for certain commodities;

- spacing of cars carrying certain chemicals to reduce the opportunity of accidental mixtures in the event of a spill;
- speed reductions for trains carrying special commodities through populated areas;
- improved "hot-box" detection techniques; and
- increased inspection requirements.

The report lists many more areas where improvements could be made. The Canadian Transport Commission is continuing to work with the railway industry to upgrade its rolling stock, the road beds and routing of dangerous chemicals to minimize the risks.

The enactment at the Transportation and Dangerous Good Regulations, effective July 1, 1985, while affecting all transport modes, will probably have the most impact in road and rail transport sectors. While it is perhaps too early yet to identify specific programs which have resulted from the legislation, there is no question that all of the major shippers of petroleum and chemical products have increased their training and safety programs in order to comply.

4.3 Information Programs

4.3.1 Safety Associations. While the role of safety associations is important to society as a whole, the Working Group does not consider that there is a significant impact of these particular programs vis-à-vis Bhopal-type incidents. Nevertheless, we would be remiss if these programs were not mentioned.

We are fortunate, in Canada, to have a comprehensive listing of associations (Land et al., 1985). The sixth edition brings together, in one compact document, listings for over 12 000 associations. International and foreign associations, with offices and branches in Canada, national, inter-provincial associations are included. Thirty-eight associations, listed in Table 3, are given in this Directory under the entry for 'Safety'. Another eighteen are listed under 'Industrial Safety' and these are given in Table 4.

4.3.2 Canada Centre for Occupational Health and Safety (CCOHS). CCOHS was established in October 1978 "to promote the fundamental rights of Canadians to a healthy and safe working environment". It is a Crown corporation, reporting through the federal Minister of Labour but governed by a Council representing federal, provincial and territorial governments, labour and employers. The Centre has a specific charter as laid out in the Act which established it. Programs centre mainly on information exchange through a computerized retrieval system.

TABLE 3 SAFETY ORGANIZATIONS

Academie de sauvetage du Quebec inc.
Alberta Safety Council
Association de securité des exploitations forestiéres du Québec inc.
Association de securité des pâtes et papiers du Québec inc.
Association for Canadian Registered Safety Professionals
Association of Canadian Security Services
Association paritaire de prevention pour la santé et la securité du travail
British Columbia Safety Council
Burnaby Safety Council
Canada Safety Council
Canadian Alarm and Security Association
Canadian Lifeboat Institution
Canadian Society of Air Safety Investigators
Canadian Society of Safety Engineering
Capital Region Safety Council
Chemical Industries Accident Prevention Association
Chilliwack and District Safety Council
Coquitlam and District Safety Council
Farm Safety Association Inc.
Grain, Feed and Fertilizer Accident Prevention Association
Industrial Accident Victims Group of Ontario
Kelowna and District Safety Council
Langley and District Safety Council
La Ligue de sécurité du Québec
Manitoba Safety Council
Metal Trades Accident Prevention Association
Motor Vehicle Safety Association
New Brunswick Safety Council Inc.
North Shore Safety Council
Nova Scotia Lifeguard Service
Nova Scotia Safety Council
Ontario Retail Accident Prevention Association
Ontario Safety League
Ottawa-Carleton Safety Council
The Royal Life Saving Society Canada
Saskatchewan Safety Council
Service national des sauveteurs inc.
Traffic Injury Research Foundation of Canada
Vancouver Safety Council

The Centre provides its services to industry, governments and the public. Much of the information relates to chemical characteristics and properties affecting health. For example, virtually all CCPA member companies provide their safety data sheets to the Centre and these are available to the public at no charge.

TABLE 4 INDUSTRIAL SAFETY ORGANIZATIONS

Accident Prevention Association of Manitoba
Association de securité des exploitations forestières du Québec inc.
Association de securité des industriels forestiers du Québec inc.
Association des securité des pâtes et papiers du Québec inc.
Association for Canadian Registered Safety Professionals
Association paritaire de prévention pour la santé et la securité du travail
Ceramics and Stone Accident Prevention Association
Chemical Industries Accident Prevention Association
Construction Safety Association of Ontario
Electrical Utilities Safety Association of Ontario
Food Products Accident Prevention Association
Forest Products Accident Prevention Association
Industrial Accident Prevention Association of Ontario
Industrial First Aid Attendants Association of British Columbia
Leather, Rubber and Tanners Accident Prevention Association
Mines Accident Prevention Association of Ontario
Occupational Health and Safety Council of Prince Edward Island
Ontario Pulp and Paper Makers Safety Association

The Working Group feels that the Centre should play a much more important role in information exchange and suggests that a more positive relationship be established by all parties having need for data on occupational health and safety including health departments, labour agencies, Workmen's Compensation Boards, Statistics Canada and industry associations.

4.3.3 Other Sources. A relevant collection of information is available from a publication of Corpus Information Services (Trimarco, 1982). This document lists over 200 pieces of legislation, over 100 government departments, agencies, boards and commissions and over 100 national and provincial associations, societies, labour organizations and educational institutions. Publications from these societies, including those from other countries, are numerous. Of special interest are those from the International Labour Office (1972), Van Nostrand - Reinhold Publishing Co. (Sax, 1984), National Safety Council (1981), Her Majesty's Stationery Office (1978), and the American Conference of Government and Industrial Hygienists (1980).

Various provincial and federal government departments have produced documents to cover special areas of industrial hazard. In the case of laboratory safety, a recent publication (Environmental Health Directorate, 1985) provides a 'Code of Conduct'for managers and personnel associated with laboratories and a previous review

(Withey, 1982) surveyed the literature on the health and safety of laboratory works in Canada.

Numerous publications cover the aspects of organization and implentation of laboratory safety practices (National Academy of Sciences, 1980; National Safety Council, 1981; Fawcett, 1972; Her Majesty's Stationery Office, 1978; National Chemical Laboratory, 1964; Steere, 1971;).

An example of a provincial government program is the handbook on the symptoms and treatment of pesticide poisoning, produced by the department of the Alberta Environment (Kelly, 1985). Pamphlets similar to those entitled 'Chlorine at the Worksite' and 'Ammonia at the Worksite' are also published by the Alberta Occupational Hygiene Branch (1985). The College, University and School Safety Council of Ontario (CUSSCO), assisted by the Safety Education Division of the Worker's Compensation Board holds an annual conference and publishes a newsletter every two months (CUSSCO, 1985). The Advisory Council on Occupational Health and Occupational Safety of the Ontario Ministry of Labour publishes an annual report every March.

5 REACTION TO BHOPAL-TYPE INCIDENTS

As was stated earlier the shock waves caused by the Bhopal incident reverberated throughout the world. Canada was no exception and Working Group 2 undertook an assessment of the reaction of the Canadian Chemical and Petroleum Industries to this event. The following is a summary of the findings.

5.1 Chemical Industry

Prior to the Bhopal incident the Canadian Chemical Producers' Association developed a policy of "Responsible Care". Under this policy the association encourages its members to exercise responsible care for ensuring that their products do not present an unacceptable level of risk to its employees, customers, the public and the environment. Acceptance of the guiding principles contained in the policy is now a condition of membership.

Two programs may be developed which deal with safety assessment and responsible care practices. The safety assessment program has already been developed and is shown in Appendix II-3.

On December 17, 1984, at a special meeting, the CCPA Board of Directors recommended that each member company of the Association carry out an immediate safety audit of its operations and report to CCPA. When this was accomplished, 64 of the 65 member companies provided a prompt response to the audit. Four of the respondents did not feel a need to carry out a formal audit for the following reasons:

- one company uses two substances that could be considered dangerous but the company is thoroughly audited by the suppliers of those two substances and its insurers on a regular basis;
- one company uses no dangerous substances other than corrosive liquids. This company did a form of audit sufficient to satisfy itself, that any spill or leak would be confined to the plant site and existing procedures would be satisfactory to respond to it; and
- two other companies use limited numbers of dangerous chemicals in such small quantities that in the event of a mishap they would not escape from plant site.

Twenty companies specifically mentioned their use of international or North American audits or the Five Star International Rating System (see Appendix II-4). This is important, since many of these companies are the smaller or medium sized CCPA

members that might not be expected to have the resources necessary to develop sophisticated audit systems themselves. These companies have, however, access to comprehensive audits developed by parent companies or affiliates, or they have recognized the advantages of using an existing system like Five Star.

Eight member companies reported that there is no likelihood of their becoming involved in a Bhopal-like incident. The companies reached this conclusion based upon the types of dangerous substances (if any) they use or handle, the types of operations they carry out and the shipment sizes for their products.

A common outcome of the audit process was upgrading precautions for a specific material produced or used by the company. A number of companies are also improving training and procedures for fire fighting and liaison with local fire departments. One company reviewed all the potentially dangerous chemicals it handles. It found that additional precautions were necessary to further enhance safety factors for one potentially hazardous raw material. Following an audit one company removed products from a warehouse with floor drains connected to the city's sanitary sewers and placed them in a warehouse with an adequate containment system. Visits by local fire officials and representatives of the provincial environment ministry were arranged.

In general, CCPA member companies underwent an audit that showed most of their existing safety programs could be improved. These improvements usually represented fine tuning and the follow-up to Bhopal was viewed as an opportunity to improve existing safety and loss control programs.

5.2 Petroleum Refining Industry

With a few exceptions many of the petroleum refineries are linked to large international corporations. As is the case in the chemical manufacturing sector, these petroleum companies are regularly exposed to internal and external safety audits conducted by the companies themselves and others such as insurance companies.

As a direct result of Bhopal, the Petroleum Association for Conservation of the Canadian Environment (PACE), who for the past 15 years have concentrated on spill prevention, control and emergency response, expanded their activity to include community participation in emergency planning.

5.3 Oil and Gas Production Sector

The oil and gas production sector suffered a Bhopal-like incident in the fall of 1982 when an Amoco gas well being drilled at Lodgepole, Alberta went out of control.

For two months, the blowout continued, the lives of two workers were lost and at times people residing near the blowout, feared for their health and safety. A public enquiry was held, 39 recommendations were made and the industry and government agencies are implementing these recommendations.

A summary of the recommendations and actions as prepared by the Alberta Energy Resources Conservation Board for the two most important areas follows:

(i) Reduce Blowouts

While blowouts cannot be totally eliminated, they can be significantly reduced. The Panel has recommended that:

- new strict rules apply to drilling critical sour wells, to ensure careful planning, superior equipment and well trained crews;
- the design, capacity and operating problems of key components of drilling rigs be carefully examined to determine whether changes are necessary;
- drilling operations in the critical zone be conducted in a cautious manner;
- ERCB increase both the number and completeness of its inspections of drilling operations; and
- the training of drilling personnel be improved.

Each of these recommendations has been implemented or is under active consideration.

(ii) Reduce Effects of a Blowout

If a blowout were to occur the Panel believes that its effect can be reduced by:

- requiring a site-specific emergency response plan for critical sour wells;
- ensuring effective coordination of government response to the blowout;
- ensuring effective communication with the public and particularly with the people residing in the immediate area;
- ensuring that H_2S exposure limits are appropriate - especially for sensitive people; and
- ensuring that H_2S concentrations are carefully monitored and the information made available to the public.

Most of these recommendations have been at least partially implemented.

The industry has also worked with government agencies to develop a policy on the ignition of a critical sour gas well in the event of an accident. This policy was announced by Alberta Public Safety Services in October, 1985.

Safety audits of gas plants are now a routine activity of this industry sector which has already responded to its own "Bhopal". While no fatalities were incurred in the general public at Lodgepole, the signficant human health threat ranks this incident as a potential "Bhopal" in the same vein as Mississauga mentioned earlier. The Working Group therefore concludes that the ERCB and other regulatory agencies as well as the industry itself have learned from Lodgepole and steps are being taken to prevent future accidents.

5.4 Other Industry Sectors

Although the Working Group did not formally review the accident prevention programs of other major industry sectors such as pulp and paper and mining, plants in these sectors can be major users of the types of chemicals discussed.

(1) Pulp and Paper. The pulp and paper sector is essentially a chemical process industry using one of the major hazard chemicals, chlorine. For several years now the industry has been substituting chlorine with less-toxic bleaching chemicals, such as oxygen, in some processes. While economics and productivity are important considerations here, the safe handling of chemicals factor also enters in. The same idea can be extended to the pulping processes where again less-toxic chemicals processes are being investigated. While no specific details were provided the Working Group understands many companies reviewed their procedures for handling and storage of chemicals especially after the chlorine release at Fort Frances in November 1984. This has involved reductions of inventories where possible.

(2) The Mining Industry. While the Working Group did not undertake a thorough review of the programs of this industry sector, there is a record of some particular industry measures. The Noranda group, for example, have conducted safety audits at all of their plants where deficiencies have been identified, actions have and are being undertaken to correct them. Another company is undertaking a review of its inventory requirements for dangerous chemicals. In one case it has been estimated that SO_2 quantities can be reduced by over 80% through simply ordering by tank truck load rather than train car lots. Audit programs are underway at one facility in light of its proximity to a major transportation corridor.

There are probably more examples which could be found; however, the Working Group concludes that there probably is a need for increased effort in this major user industry.

6 WORKER AND COMMUNITY AWARENESS

One of the key issues to surface as a result of the Bhopal accident, is the "community right to know" issue. Following that tragedy, people living in the vicinity of chemical facilities asked the question: "What is going on behind that plant fence that could affect me?" This is a legitimate question and one that requires an answer.

Today people living in surrounding communities adjacent to chemical or petroleum complexes want to know the hazards to which they are potentially exposed. Working Group 2 is of the opinion that companies have a responsibility to inform the public as to what chemicals are being handled and their hazardous properties.

Companies have an obligation to inform not only their workers about the hazards of the chemicals they are exposed to on the job, but also local officials and residents should have access to the same health and safety information that is available to employees.

Many companies have urged their managers to be good neighbours, open their plants to visit from the public and to participate in local meetings to achieve a better understanding of the role of the industry and the community. Many plants have brought in local police, fire and emergency measures officials into the plants to discuss the hazards of the chemicals at the site, to explain the company's safety practices and to coordinate any emergency efforts to a community response plan. In some situations companies have been able to participate in cooperation with other industries on a mutual aid basis (Part 3).

The Canadian Chemical Producers' Association together with their U.S. counterpart, the Chemical Manufacturers Association, supports the principle of community awareness. In principle, they endorse the attitude that member companies have a responsibility to provide information on hazardous chemicals to the public. This information should be adequate to meet the needs of special groups such as municipal councils, police, local fire departments, physicians, hospitals and the general public.

Plant managers are encouraged by these trade associations to work closely with local officials on emergency planning activities; these associations are prepared to assist the companies and the local communities by providing guidance on how to proceed in developing emergency response plans.

In the U.S., the Chemical Manufacturers Association has developed a community outreach program. The "Community Awareness and Emergency Response", (CAER) handbook is an excellent source of information regarding the initiation and

development of a contingency plan. Two other equally valuable sources of information include "Evaluation of Public Health Hazards Associated with Chemical Accidents" (Silvano, 1985) and the U.S. Environmental Protection Agency's recent publication, "Chemical Emergency Preparedness Program" (EPA, November, 1985).

Working Group 2 supports the initiatives taken by industry and would promote its universal application across Canada, in strengthening the communication programs between local industries and local communities.

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APPENDIX II-1

LIST OF OCCUPATIONAL HEALTH, SAFETY AND RELATED ENVIRONMENTAL LEGISLATION

APPENDIX II-1 LIST OF OCCUPATIONAL HEALTH, SAFETY AND RELATED ENVIRONMENTAL LEGISLATION

FEDERAL

Canada Labour Code
Canadian Centre for Occupational Health and Safety Act
Environmental Contaminants Act
Federal Workers' Compensation Legislation

PROVINCIAL

Alberta

Hazardous Chemicals Act
Occupational Health and Safety Act
Transportation of Dangerous Goods Control Act
Workers' Compensation Act

British Columbia

First Aid (Industrial) Regulations
Health and Safety Divisions from the Factories Act
Industrial Health and Safety Regulations
Labour Regulation Act
Mines Act
Workers' Compensation Act
Waste Management Act
Environment Management Act
Emergency Program Act

Manitoba

Environmental Accident (Spills) Provisions from Clean Environment Act
Transportation of Dangerous Goods Act
Workers' Compensation Act
Workplace Safety and Health Act

New Brunswick

Occupational Health and Safety Act
Occupational Health and Safety Commission Act
Workmen's Compensation Act

Newfoundland

Asbestos Exposure Code
Employers' Liability Act
Occupational Health and Safety Act
Transportation of Dangerous Goods Act
Workers' Compensation Act

Nova Scotia

Industrial Safety Act
Occupational Health Regulations
Transportation of Dangerous Goods Act
Workers' Compensation Legislation

Ontario

Dangerous Goods Transportation Act
Guidelines for Response to Environmental Health Emergencies
Guidelines on Occupational Health Hazards
Occupational Health and Safety Act
Spill Provisions from Environmental Protection Act
Workers' Compensation Act

Quebec

Industrial and Commercial Establishments Regulations
Occupational Health and Safety Act
Workmen's Compensation Act

Saskatchewan

Environmental Spill Control Regulations
Occupational Health and Safety Act, 1977
Workers' Compensation Act

APPENDIX II-2

PERSONNEL SAFETY TRAINING CRITERIA

APPENDIX II-2 PERSONNEL SAFETY TRAINING CRITERIA

Employees in the Chemical and Petroleum Industries are given extensive training before they are assigned to work in plant operations. Particular emphasis is given to training of new employees, but upgrading and refresher courses for trained supervisors and operators is also part of industry practice. The following tables provide a typical training matrix used by companies to identify training requirements for various job levels.

PERSONNEL SAFETY TRAINING CRITERIA BY JOB CATEGORIES

TRAINING CRITERIA TOPICS		OPERATORS	MAINTENANCE	MATERIAL HANDLERS & DISTRIBUTION	LAB. PERSONNEL	STORES/RECEIVING	OFFICE/AUXILIARY STAFF	SUPERVISORS: OPERATION	SUPERVISORS: MAINTENANCE	SUPERVISORS: DISTRIBUTION	TECHNICAL STAFF	DEPARTMENT HEAD	PLANT MANAGEMENT	SELECTIVE GROUP	FREQUENCY
New Employee Safety Indoctrination		M	M	M	M	M	M	M	M	M	M	M	M		A
Safety for Supervisors								M	M	M	R	R	R		A
Department Safety Training Program		R	R	R	R	R	R	R	R	R	R	R	R		A (1) D
Incident/Accident Reporting & Investigation	5-7	M	M	M	M	M	M	M	M	M	M	M	M		A (2) C*
Facility/Operation Change Review	5-25							M	M	M	M	M	M		A (3) C
Basic Safety Rules	5-1	M	M	M	M	M	M(P)	M	M	M	M	M	M		A (2) C
Safe Work Permit	5-21	M	M	M	M	M		M	M	M	M	M	M		A (2) C
Confined Space Entry	5-23	M	M	M	M[1]			M	M	M	M	M	M		A (2) C
Master Card	5-19	M	M	M	M			M	M	M	M	M	M		A (2) C
Radiation Control Proc.	5-10													M[2]	A (2) C
Plant Emergency	5-15	M	M	M	M	M	M(P)	M	M	M	M	M	M		A (2) C
Basic First Aid														M	A (3) B[5]
Scott Air Pak	5-23	M	M	M	M	M		M	M	M	M	M	M		A (2) B
Respiratory Protection	5-47	M	M	M	M			M	M	M	M	M	M		A (1) C
Hearing Protection		M	M	M	M			M	M	M	M	M	M		A (2) C*
Safety Shower/Eye Bath		M	M	M	M	M	M	M	M	M	M	M	M		A
Fire Extinguishers		M	M	M	M	M	M	M	M	M	M	M	M		A (4) B
Combustible Gas Analysers	5-46	M		M	M			M		M	M	M			A (3) B
Interlock By-Pass		M						M	M	M	M	M	M	M	A (3) C
Colorimetric Tube Tester		M		M	M			M		M				M[3]	A (3) B
Stop Program		M	M	M	M	M	M	M	M	M	M	M	M		A
Disaster Plan								M	M	M	M	M	M		A (1)[4]
Fertile Women Protection												M		M	A (3) B
Specific Unit Training															6

* To be covered in safety rules

1. Gas Lab Only
2. Poly Ops. & Tec. Staff T&I & Instr. Tech.
3. Operators: Olefins, Chemicals, Gas Lab.
4. Emergency Drill
5. Members of Emergency Squads Stand by attendant Plant Guards
6. See Unit Program

A - Initial Training
B - Compulsory Retraining
C - Written Test Every (No.) Years Perform Corrective Training
M - Mandatory
R - Recommended
P - Partial

PERSONNEL SAFETY TRAINING CRITERIA BY JOB CATEGORIES

TRAINING CRITERIA TOPICS	OPERATORS	MAINTENANCE	MATERIAL HANDLERS & DISTRIBUTION	LAB. PERSONNEL	STORES/RECEIVING	OFFICE/AUXILIARY STAFF	SUPERVISORS: OPERATION	SUPERVISORS: MAINTENANCE	SUPERVISORS: DISTRIBUTION	TECHNICAL STAFF	DEPARTMENT HEAD	PLANT MANAGEMENT	SELECTIVE GROUP	FREQUENCY
Stanby Attendant													M[7]	A (2) B
Liquified Petroleum Gas	M[8]	M[8]	M[8]	M[8]			M[8]	M[8]	M[8]	M[8]	M[8]			A
Anhydrous Ammonia	M[9]	M[9]	M[9]	M[9]			M[9]	M[9]	M[9]	M[9]	M[9]			A
Fork Lift Trucks	M[10]		M[10]		M		M[11]						M[12]	A (3) B
Cranes													M[13]	A (3) B
Benzene	M[14]	M[14]	M[14]	M			M[14]	M[14]	M	M[14]	M[14]	M[14]		A (1) C
Drip A & B	M[14]	M[14]		M[14]			M[14]	M[14]		M[14]	M[14]	M[14]		A (1) C
Ethylene Oxide	M[15]	M[15]	M[15]	M[15]			M[15]	M[15]	M	M[15]	M[15]	M[15]		A (1) C
Cellosolves	M[16]	M[16]	M[16]	M[16]			M[16]	M[16]	M	M[16]	M[16]	M[16]		A (1) C
Electrical		M[17]						M[17]		M[17]	M[17]			A (3) C
Electrical Hot Work		M[17]						M[17]		M[17]	M[17]			A (3) C
Elevated Work	M	M	M				M	M	M	M	M	M		A (3) C
Hot Tapping		M[18]						M[18]			M	M		A
Cranes Under Power Lines													M[13]	A (3) C
Hand Abrasive Blasting		M[19]						M[19]						A (1) C
Asbestos		M[20]						M[20]						A (3) C
Oxygen Detectors				M										A (1) B
Trenching & Excavation		R[21]					R	R	R	R	R	R		A (3) C
Hazards Communication							M	M	M	M	M	M		A
Applicable Haz Material														6
Portable Ladders	R	R	R	R	R		R	R	R	R	R	R		A
Lifting Methods	M	M	M	M	M	M	M	M	M	M	M	M		A (3) C
Hand Safety	M	M	M	M	M	M	M	M	M	M	M	M		A
Applicable Pers. Prot. Equip.	M	M	M	M	M	M	M	M	M	M	M	M		6 A (3) C
Hose Handling	M	M	M	M	M		M	M	M	M	M	M		A
Vapour Cloud	M	M	M	M	M	M	M	M	M	M	M	M		A (2) C

7. Members of Maintenance and Operation
8. Personnel from the Olefins Department
9. Personnel from Oxyde Derivative
10. Personnel From Compounding
11. Sup. Comp. & Stores
12. Maintenance Mechanic Working on Fork Lift Truck
13. Specific Group From Maintenance
14. Personnel in Contact with Product
15. Personnel From Chemical Area
16. Personnel From ODU, PCU & ASS. Maintenance
17. Electrical Dept.
18. Selective Welders, Pipefitters & Maintenance Supervisors
19. Selective Maintenance Individuals
20. Pipefitter, Insulators, Riggers Laborers
21. Laborers, Pipefitters, Riggers

FIRE SAFETY TRAINING CRITERIA BY JOB CATEGORIES

TRAINING CRITERIA TOPICS	SELECTED GROUPS	EMERGENCY SQUAD	EMERGENCY COORD. & BACK UP	OPERATORS	MATERIAL HANDLERS & DISTR. PERSONNEL	MAINTENANCE	LAB. PERSONNEL	SHIFT SUPERVISORS	TECHNICAL STAFF/ DEPARTMENT HEADS	PLANT MANAGEMENT	OFFICE PERSONNEL	FREQUENCY
Fundamental of Fire & Inerting		M	M	MP	MP	MP	MP	MP	MP	MP	MP	A (5) C
Extinguishers	M[1]	M	M									A (2) B
Fire Alarm System & Action		M	M	MP	MP	MP	MP	MP	MP	MP	MP	A (2) C
Fire Water Supply	MP[1]	M	M	MP	MP			MP	MP			A (3) C
Water Spray, Sprinklers & Others		M	M	MP	MP			MP	MP			A (3) C
Fixed Monitors & Hydrants		M	M	MP	MP	MP		MP	MP	MP		A (3) C
Hose Handling & Storage	MP[1]	M	M									A (2) B
Emergency Equipment Truck		M	M									A (2) B
Foam Equipment		M	M									A (2) B
Fire Protective Clothing	MP	M	M									A (2) B
Vapour Cloud Procedure	M	M	M	MP	MP	MP	MP	MP	MP	MP	MP	A (2) C
Fire Fighting Guidelines		M	M									A (2) B
Close Roof Tank Fires		M	M									A (2) B
Pressure Fires		M	M	RP	RP			RP	RP			A (3) C
Spill Fires		M	M	RP	RP			RP	RP			A (3) C
Runaway Reaction		M	M	RP	RP			RP	RP			A (3) C
Electrical Fires	RP	M	M	RP	RP			RP	RP			A (3) C
Fire Water Demand - Hydraulic	M	M	RP	RP			RP					A (2) B
Emergency Communications	M	M	M					M	M	M		A (2) B
Back Up & Emergency Ass.			M									A (2) B
Emergency Director Training [2]			M									A
Supplies & Stores			M									A
Hazardous Materials		M	M									A (2) B
Radioactive Materials			M									A
Gas Detection Systems		MP	MP	MP	MP			MP				A

TRAINING TYPE CODE:

M - Mandatory
R - Recommended
P - Partial

FREQUENCY CODE:

A - Initial
B - Compulsory Rurry (No.) years
C - Check Proficiency Every (No.) years

1. Entry attendant, welders.
2. In accordance with C & P Emergency Director Training Program.

APPENDIX II-3

CANADIAN CHEMICAL PRODUCERS' ASSOCIATION SAFETY ASSESSMENT SYSTEM

Note: Only the first few pages of the "Assessment System" are included in this Appendix.

APPENDIX II-3 CANADIAN CHEMICAL PRODUCERS' ASSOCIATION SAFETY ASSESSMENT SYSTEM

ESSENTIAL COMPONENTS OF SAFETY AUDIT SYSTEMS

Introduction

The board of directors of the CCPA determined at its 1984 December meeting to have a document prepared outlining the Essential Components of Safety Audit Systems, consistent with CCPA's Statement of Policy on Responsible Care.

A task group was formed with the following members:

R. Burrell	C-I-L Inc.
T. Christie	Cyanamid Canada Inc.
J. Cowan	Hercules Canada Inc.
R. Egedahl	Dow Chemical Canada Inc.
D. Ford	Dow Chemical Canada Inc.
D. Goffin	CCPA
F. Hager	UNIROYAL Limited
F. Hovland	Du Pont Canada Inc.
K. James	ERCO, A Division of Tenneco
S. O'Shea	Du Pont Canada Inc.

The group concluded that the best approach was to prepare a Guiding Statement for each major topic, with a listing of key considerations against which an assessment could be made by each member firm with respect to definition, communications, training and auditing of the issue.

The document is intended as an aid to self-assessment by each member firm to determine its emergency preparedness and adequacy of safety programs.

It is recommended that feedback to the CCPA be provided to facilitate an overview of the state of safety programs in the Canadian chemical industry, and to indicate areas where further assistance from the CCPA to its membership may be appropriate. A suggested report sheet for providing this feedback is included in this report.

A reference list for the assistance of member companies in developing or upgrading safety programs is also provided.

F. Hovland
Chairman

Index

Part I INTERNAL PROGRAMS

- The Role of Management in the Safety, Health and Loss Control Program.
- The Design and Construction of Chemical Manufacturing Plants.
- Modifications to Plant or Process.
- Safe Plant Operations.
- Maintenance Programs.
- Safety, Health and Loss Control Programs.
- Environmental Programs.
- Security.
- In-plant Emergency Control.

Part II EXTERNAL PROGRAMS

- Identifying the Potential Impact of Emergencies.
- Development of the Emergency Plan Framework.
- The Community Emergency Plant.
- Communications with the Community.
- Legal Aspects of Emergency Planning.

Part III SAFETY AUDIT SYSTEMS REPORT SHEET

Part IV REFERENCE LIST

For Illustration Purposes "PART-I INTERNAL PROGRAMS" is included.

To Obtain Copies of the Complete Document, Please Contact:

The Canadian Chemical Producers' Association
Suite 805, 350 Sparks Street
Ottawa, Ontario
K1R 7S8

Tel: (613) 237-6215

PART I - INTERNAL PROGRAMS

Part I consists of sets of questions covering nine major topics on internal operations. The questions are intended for use by CCPA member companies in conducting self-assessments to determine whether present programs are adequate.

Each set of questions is presented in the format of a check sheet having three check boxes for individual questions. The first check box asks whether the company has something in the way of a defined program or procedure covering the questions posed. The second box asks whether the key elements referred to by the question have been communicated to relevant audiences and/or whether appropriate personnel have been trained in the key element. The final box addresses whether an audit has been performed to test how effectively the key elements have been defined and trained or communicated.

THE ROLE OF MANAGEMENT IN THE SAFETY, HEALTH AND LOSS CONTROL PROGRAM

Guiding Statement

The directors and management at all levels of the company are committed to the preservation of the safety and health of its employees and the protection of the environment and the community. They have clearly stated policies and active programs to continuously manage risks and compliance with government regulations, to allocate corporate resources for necessary prevention and precautionary systems, to regularly audit and test the effectiveness of these measures and to obtain the commitment of all employees to the policies and programs themselves.

Key Considerations

		DEFINED ?	TRAIN/ COMMUNICATE ?	AUDIT ?
1)	Does the company comply with the CCPA "Responsible Care Statement"?	☐	☐	☐
2)	Does the company have a statement of policy signed by the Chief Executive Officer and communicated to all employees?	☐	☐	☐
3)	Does management at all levels exhibit leadership in establishing safety, health and loss control goals and does management provide the necessary ressources and demand accountability?	☐	☐	☐
4)	Are regular reviews of safety, health and loss control programs carried out at senior management levels?	☐	☐	☐
5)	Does the company have written safety, health and loss control guidelines for all locations?	☐	☐	☐
6)	Does the company make safety, health and loss control a part of every employee's job responsibility?	☐	☐	☐

7) Are programs are in place for initial training and retraining of all employees? ☐ ☐ ☐

8) Are thorough audits and tests conducted periodically to monitor compliance with requirements and to provide the basis for specific management action? ☐ ☐ ☐

9) Are lines of communication in place so that safety, health and loss control programs are brought to the attention of management having the authority to implement the corrective action required? ☐ ☐ ☐

10) Does the company maintain emergency plans which define specific responsibilities for all personnel and does it coordinate the plans with the local community? ☐ ☐ ☐

APPENDIX II-4

INTERNATIONAL SAFETY RATING SYSTEM
FIVE STAR PROGRAM

APPENDIX II-4 INTERNATIONAL SAFETY RATING SYSTEM FIVE STAR PROGRAM

The International Safety Rating System is a copyrighted safety audit program offered by the Industrial Accident Prevention Association of Ontario. It is essentially a diagnostic tool designed to highlight the strengths and weaknesses of an organization's safety management system. As such, it evaluates the effectiveness of the system in preventing work injuries and occupational illness in the workplace. It is based on the employer's responsibilities and expects more than compliance with government regulations. It verifies the existence of management programs which have been developed to ensure that the enterprise is properly managing health and safety in the workplace. Such programs aim to eliminate or control all work hazards and minimize risk to workers.

It consists of 579 scored standards in question form, grouped into 20 elements to cover a complete health and safety review. It is a progressive system that can be implemented at ten levels of attainment, comprising of basic core questions to which further questions can be added to achieve higher levels of sophistication.

The key to the success of the "Five Star Program" lies in its non-traditional view of what constitutes an accident. An accident had been previously defined as the result of an unsafe condition in combination with unsafe act. This definition led to a reactive system of accident correction. Under the "Five Star Program" an accident is viewed as a breakdown of the management system. With this approach, when an accident occurs, the resulting changes are directed toward improving the management system to prevent such future losses from taking place.

In the "Five Star Audit Program" 20 elements may be addressed. These include:

1. Leadership and Administration,
2. Management Training,
3. Planned Inspections,
4. Job Analysis and Procedures,
5. Accident/Incident Investigation,
6. Planned Job Observation,
7. Emergency Preparedness,
8. Organizational Rules and Regulations,
9. Accident/Incident Analysis,

10. Employee Training,
11. Personal Protective Equipment,
12. Health Control and Services,
13. Program Evaluation System,
14. Purchasing and Engineering Controls,
15. Personal Communications,
16. Group Meetings,
17. General Promotion,
18. Hiring and Placement,
19. Records and Reports, and
20. Off-the-Job Safety.

In many cases the program requires the answers to questions to be supported by documentation. In other cases an observation of the physical facilities or interviews with management and workers will provide answers to the **actual** working of a program compared to the program as perceived.

Value factors have been assigned to each of the questions, enabling an organization to measure its activities in quantifiable terms.

APPENDIX II-5

EXAMPLES OF INDUSTRY ACCIDENT PREVENTION MEASURES DURING ENGINEERING DESIGN AND CONSTRUCTION

APPENDIX II-5 EXAMPLES OF INDUSTRY ACCIDENT PREVENTION MEASURES DURING ENGINEERING DESIGN AND CONSTRUCTION

By way of example, to illustrate industry activities in the identification and management of hazards, both actual and potential, two Petro-Canada projects, one involving a new commercial process and the other replacing an existing unit, were reviewed. At the time of drafting this report, both projects were in the final stages of construction and commissioning.

In each case from design to operation, great emphasis was placed on the development of proper procedures and personnel training so that work is properly carried out.

At each stage, audits were performed by appropriate teams. These audits will continue through the life of the plant.

As a result of technology developed by Energy, Mines and Resources (EMR) Canada, a new process called CANMET hydrocracking has emerged. The first commercial plant has been constructed in Point-aux-Trembles, Quebec, and is in the process of commissioning at this time.

The second case concerns the replacement of a catalytic cracking process unit, in which a completely new reactor/regenerator system was constructed alongside the existing on-line system without incident.

THE CANMET DEMONSTRATION PLANT

Conceptual design and scale up from pilot plant operation commenced in May 1981, the contractor selected has experience in the design of high pressure, high temperature plants.

Engineering Procurement and Construction Management (EPCM) was contracted to a Canadian based contractor with worldwide EPCM experience. The following groups from the host company become actively involved with the EPCM: Projects, New Technology, Control Systems, Refinery Operations, Process Engineering, Technical Services and Refinery Engineering.

During the course of the project cycle the following actions were taken:

1) EPCM contractor and the Petro-Canada project group developed the necessary engineering standards and specifications using as a base the existing refinery standards.

2) A materials Review Group was formed to review the metallurgy recommended by the contractor. This specialist group was supported by the refinery inspection staff. Technical Services and EMR (CANMET), New Technology provided the design criteria to monitor corrosion.

3) Early in 1981, a consultant in Safety and Loss Control was engaged with experience in high pressure hydrogen process and catalytic cracking and coal liquefaction to fill in needed knowledge gaps.

4) A Hazard and Operability Review Committee was formed and met regularly from October, 1983. This group involved the EPCM contractor and Petro-Canada personnel from the Refinery Technical Services, Engineering and Projects groups and, Industrial Hygiene and Safety.

5) An independent risk analysis was performed by Canadian Industrial Risk Insurers who reviewed plant layout from the design to field installation.

6) Environmental Permits - all the necessary permits for the project from the Montreal Urban Community and the Province of Quebec were obtained by the refinery management without delay.

7) A start-up task force comprising people from Refining, Engineering (New Technology), and the EPCM contractor was formed to develop detailed start-up, operating and emergency procedures.

8) A partial list of the documents developed follows to illustrate more fully the work of this task force.

9) Risk analysis was carried out - to determine problem potential (a part of HAZOPS reviews) in the form of - if, what if, so what, operating philosophy.

10) Operating manuals were written by refinery personnel supported by the task force for start-up, shutdown and emergency procedures. In addition, a consultant specializing in the commissioning of high pressure process plants was engaged to assist in this work.

11) A process simulator was purchased to assist in operator training and the development of start-up, normal operations and emergency shutdown procedures using a variety of feed rates and types, and product disposal routes.

12) An Atomic Energy Control Board (AECB) approved nuclear densitometer forms a part of the instrumentation. The refinery inspectors are qualified and licenced by the AECB to operate this device.

13) The CANMET process includes an additive preparation section which is not part of conventional refinery operations and particular care has been taken in the design and operation of this section.

14) During the construction phase, the EPCM contractor, refinery, and contracted inspectors monitored all phases of construction.

15) The insurers witnessed and/or reviewed test certificates of tests, including all fire equipment and tests of the deluge system.

Regular reviews were made to ensure that proper engineering and construction practices were followed in addition to statutory inspections of relief valves, welding and vessel testing to comply with Department of Labour requirements.

THE CATALYTIC CRACKING PROCESS UPGRADING

In early 1983, it was decided to replace the existing Houdry catalytic cracking unit which was nearing the end of its useful life and was not able to meet the environmental air and emission standards.

An Engineering and Development and Refinery Engineering department task force was created to review existing fluid catalytic cracking technology. As a result of this review, a process developed by Total Petroleum was selected.

This process, which uses two-stage regeneration, is relatively new, with only two similar units in operation. It represents a first time use for Canada.

A licence to build the unit was obtained from Total Petroleum, and an experienced contractor was engaged to design the new unit and to modify the existing fractionation and gas recovery sections.

Funding for this project was approved in February 1984 for scheduled completion in the autumn of 1985.

At the time of writing of this report the plant was in the later stages of construction and each activity used to control the CANMET construction and operation was duplicated for the "Total" process. These included engineering standards and

specifications, materials review, safety and loss control, hazardous operations review, risk analysis and start-up task force.

The most significant thing to consider in any upgrading process is that the work site is within the boundaries of an operating plant. Nothing can be done without considering the operation. No work can be started unless the appropriate permits are prepared and constant monitoring at each work site is required. This means literally that every piece of work, including all cold work, hot work such as welding, safe entry into confined spaces, is checked and the appropriate permits issued specifying the applicable conditions.

The engineering review process revealed the need for major changes in areas such as hot slurry piping catalyst handling, and the quench oil systems.

To assist both the refining and engineering groups in resolving problems of operability, safety and construction, a model was built and used extensively by all groups.

The Canadian Underwriters reviewed plant layout, fireproofing and fire equipment and prepared a risk analysis. Operating procedures for start-up, shutdown and emergencies have been prepared along with operator training programs.

Loss control is a requirement which can only be achieved through team work and cooperation.

PART III

RESPONSE

Report of Working Group 3

A Review of Measures Taken by Industries and Governments to Prepare for and Respond to Major Industrial Incidents in Canada

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SUMMARY

This report examines the measures taken by industries and governments to prepare for, and respond to major chemical accidents in Canada. The magnitude of Bhopal-type incidents is so great, and the events can develop so quickly that the primary effort must be in their prevention. There are some technical, economic and logistical limits to the abilities of both industries and governments to confine, or to limit damage from a major release once it has occurred. Fortunately, accidents of major magnitude have been extremely rare in Canada. The main efforts for improving chemical accident preparedness and response by industries and governments have been for the minor and medium-sized accidents, although contingency plans do provide for escalation to major disasters. Prompt, effective response to the smaller and medium-sized releases can help to ensure that these incidents do not grow to disaster proportions. In general, industries are responding to such releases quite well.

Our review group also found that considerable work towards preparedness has been done by industries and governments for major accidents as well. While recognizing these efforts, we have also identified a number of gaps in technical knowledge, in assessment and acquisition of existing technology, and in the development of new and innovative countermeasures technology for both smaller and larger chemical releases.

Several conclusions and recommendations in this report address these gaps or needs. Such actions can help to improve our collective readiness for major incidents in Canada, but the biggest step that must be taken, is a wider understanding and acknowledgement that a major chemical accident can occur in Canada, virtually in any urban or rural location where hazardous chemicals or dangerous goods are manufactured, transported or used. With a change in outlook, people having concerns or responsibilities for preventing and preparing for such events can review their efforts and gain the needed support and resources to improve their contingency plans and their responses to hazardous chemical accidents.

1 INTRODUCTION

This report outlines the measures taken in Canada by industries and governments to prepare for and respond to Bhopal-type incidents. Canadians are aware of recent major industrial accidents that have taken place around the world, such as in Seveso (Italy), Mexico City, and most recently Bhopal. Closer-to-home incidents such as the Mississauga train derailment and the sour natural gas blow-out at Lodgepole, Alberta, have alerted the public that Canada may not be immune to such potential major disasters.

The Bhopal Aftermath Steering Committee established Working Group 3 to determine what steps are being taken to prepare for such calamities in Canada.

This group was given the following terms of reference:

a) Review the recommendations of previous evaluations for federal-provincial councils of ministers (e.g., Canadian Council of Resources and Environment Ministers, Council of Ministers of Transport and Highway Safety) and of other appropriate technical documents in regard to the whole area of response to environmental emergencies.
b) Identify the information gaps that need to be filled.
c) Review the extent of consultation between industry and governments in developing plans and preparing for accidents.
d) Make recommendations as appropriate.

Although all industrial accidents large or small are undesirable, the principal focus of this report will be on major chemical accidents as defined by the Steering Committee. These are major industrial or transportation incidents resulting in acute exposure to chemicals and which have the potential to cause death or adverse health effects in the community.

The preparations for and response to smaller but significant chemical accidents are also addressed because of the importance of preventing these incidents from escalating into major ones.

The types of major chemical accidents that this report addresses are as follows:

1) explosions or fires at a chemical manufacturing plant, oil refinery or storage facility;
2) an inadvertent release of an acutely toxic gas from a manufacturing or storage facility;

3) transportation accidents releasing large volumes of hazardous chemicals; and
4) misuse of chemicals causing a major toxic release, e.g., accidental mixtures.

Provincial and territorial input to this report was sought through the circulation of a questionnaire to a composite group of provincial agencies in each province and territory, usually coordinated by an emergency measures agency. Background information was also received from a number of provinces.

2 EMERGENCY INCIDENT READINESS AND RESPONSE

2.1 Industries

As is stressed repeatedly in this report, the magnitude of Bhopal-type incidents can be so great, and the events can happen so quickly that the primary effort must be focussed on prevention. Industrial and government capabilities to mitigate damage once a major accident has occurred are severely limited. Industrial efforts have been largely focussed on preparing for and responding to small and medium-sized chemical accidents (while still planning for major disaster scenarios), and on countermeasures to ensure that the event does not grow into a more serious accident.

In Canada, in every jurisdiction of government concerned with emergencies, the principle that is applied is "the polluter pays", i.e., the polluter is responsible for initiating the response and for all the costs of clean-ups and damage/liability. The chemical and petroleum industries and several others that are major chemical consumers have a number of levels of spill response plans in place, either as individual companies, or as mutual-aid associations. Furthermore, many individual companies are members of more than one trade association. This provides the opportunity for an exchange of ideas, information and equipment to some extent between, for example, the petroleum industry, the industrial chemical industry, chlorine producers and ammonia producers. Most of the chemical industry contingency plans also cover their products during transportation and delivery to major chemical consumers. A few commercial spill clean-up contractors are also established in Canada, but with the possible exception of some sour gas blowout control companies, they are not experienced in dealing with major incidents involving toxic chemicals.

2.1.1 The Petroleum Industry. The "upstream" (exploration and production) and "downstream" (refining and marketing) segments of the petroleum industry have, since the mid-1970s, cooperated with each other and with federal and provincial agencies in programs for oil spill prevention, contingency planning, response training and countermeasures evaluation and research. An industry-wide committee forms the Spill Response Division of PACE (The Petroleum Association for Conservation of the Canadian Environment) and meets three times a year with associated federal government representatives to coordinate this effort. The investments by the oil industry in spill programs over the years have amounted to thousands of hours of effort and many millions of dollars, including considerable funding of joint research projects with government agencies. The

net result of this substantial effort by the oil industry (represented by the Canadian Petroleum Association and its regional affiliates, and by PACE) has been the development of a comprehensive state of preparedness for small to medium-sized oil and petroleum fuel spills, and a substantial advancement in oil spill countermeasures equipment and techniques, particularly for cold climates. A further long-term effort with the federal government has resulted in a joint government-industry contingency plan for major marine oil spills

Potential releases of petrochemicals from petroleum industry refineries and product storage facilities are covered both by company contingency plans, and by plans involving response mutual aid for facilities located in areas of refinery and chemical industry concentration (e.g., in Sarnia, Ontario, the Chemical Valley Emergency Control Organization). These local plans and another national mutual aid plan called "TEAP" which covers incidents during transportation of petrochemical industry products, are discussed further in Section 2.1.2.

The propane and butane producers of the petroleum industry are represented by the Propane Gas Association of Canada (PGAC). In response to the passage of legislation under the Transportation of Dangerous Goods Act, the PGAC and its member companies (mainly the local and regional propane or butane dealers) developed a comprehensive response plan for propane and butane incidents. The PGAC plan involves a network of "Remedial Measures Advisors" or RMAs who can be called through an emergency telephone number to go to the scene of a propane or butane incident and deal with the situation. The role of RMAs may be the provision of special tools, technical advice or assistance to an on-scene commander, or on occasion, the hands-on fixing of the problem.

Another series of company response plans have been developed in the exploration, production and marketing sectors of the petroleum industry. Comprehensive oil spill response plans and specialized equipment inventories are wide-spread in the western provinces and in frontier areas of Canada (approximately 90 co-operative equipment pools currently exist). Some of this equipment is also applicable and available for certain toxic chemical spills, although not for most of the chemicals considered in this review. In the Bhopal context, however, sour gas (natural gas contaminated by hydrogen sulphide) emergency contingency plans have been required by provincial regulatory agencies for a number of years for all companies active in petroleum exploration and production. Even more comprehensive response plans have been developed in Alberta to cover potential releases of sour gas from "critical sour gas wells" having a high

concentration of hydrogen sulphide. The development of such plans and response mechanisms has been closely guided and monitored by provincial government agencies such as the Alberta Energy Resources Conservation Board and the Alberta Public Safety Services agency. In recognition of the industry's responsibilities, and the valid concerns of the public, nearby communities and provincial regulatory agencies, the Canadian Petroleum Association is developing guidelines for the preparation of company contingency/response plans for critical sour gas wells.

These guidelines outline methods of hazard assessment, company personnel responsibilities, interfacing with government agencies and the public evacuation criteria and arrangements, gas dispersion monitoring, and post-emergency procedures. In the planning process, close contact is maintained with the public, including personal interviews with all residents who could have exposure to excessive levels of hydrogen sulphide to identify those who may be handicapped or need special assistance in evacuation. The emergency plans are freely available to the public, and are generally discussed annually in open public meetings. Although implemented by industry, these plans require close involvement with affected government personnel and with the public in plan preparation.

2.1.2 The Industrial Chemical Industry. The Canadian Chemical Producers' Association (CCPA) represents companies that produce approximately 75 percent of the industrial chemicals and synthetic resins manufactured in Canada. All of these companies have signed the CCPA's responsible care statement that includes a guiding principle calling for the company to "ensure that its operations do not present an unacceptable level of risk to its employees, customers, the public or the environment". They have all considered the need for contingency plans addressing emergencies should they occur. A few companies have determined that an elaborate plan is not necessary since the companies either do not handle dangerous chemicals or the dangerous chemicals they do handle have little or no propensity to escape from the plant site. These companies have contingency plans that are similar in scope to those of the typical manufacturing facility. At the other extreme are large chemical companies that have developed comprehensive contingency plans designed to address every possible emergency scenario that could reasonably be expected to occur.

For example, CIL Inc. has Chemical Emergency Response Teams at its five major plants in Canada, managed by trained response personnel and equipped with special vehicles, basic specialized equipment and protective gear. Smaller Product

Emergency Response Teams (PERTs) are located at 12 other centres to deal with specific product releases. All of these teams are linked to a 24-hour emergency telephone call system and there is back-up support from more than 200 trained personnel within the CIL emergency response system. Such a system is representative of the larger company's standard for contingency planning and response to its own incidents.

In between these two extremes are companies that are often medium-sized and handle dangerous goods but not in the same volume or variety as the larger chemical companies. These companies have the difficult task of designing emergency plans that are suitable for the dangerous goods they handle and yet workable, recognizing that they may not have the resources of the larger chemical company.

A CCPA survey carried out early in 1985 provided some evidence that companies in this category have prepared contingency plans that are reviewed and updated either routinely, in response to serious fires or other incidents in the local municipality, or following major international incidents. However, this survey was not sufficient to conclusively demonstrate that all of these companies have adequate plans. CCPA's proposed safety assessment program described in the report by Working Group Number 2 has sections addressing in-plant emergency control, identification of the potential impact of emergencies and the development of an emergency plan framework. The overall level of preparedness of CCPA members will be more precisely determined when this assessment is completed by CCPA's membership. The CCPA will also be preparing a responsible care practice for its members that will provide them with guidelines for emergency planning.

In two areas of Canada where there is some concentration of chemical and petroleum facilities, mutual aid systems that are well integrated with the local community have been established. In Sarnia, Ontario, an industrial mutual aid plan involving the Sarnia fire department, was first developed in 1951. Now this organization functions as a committee of the Chemical Valley Emergency Control Organization (CVECO). The purpose of CVECO is to bring together key industry, fire, law enforcement and public utility personnel to formulate and put into action an emergency plan, to provide a closer relationship between members and to cooperate with authorities in the event of an emergency. Membership is open to industry and community personnel actively engaged or interested in the protection of lives, property and equipment in the industrial area of Sarnia. Over the years, the original emergency plan has been tested through regular simulations and revised and updated as needed. The end result is a thoroughly tested emergency plan that can be put into effect on a moment's notice.

The mutual aid system in Fort Saskatchewan, Alberta, is called FORT MAP. FORT MAP has a constitution and maintains separate funds and equipment not possessed by individual members. The membership incorporates a large segment of the local chemical industry, the Canadian National Railway and representation from public sector organizations including the fire department, RCMP, ambulance service and local hospital. FORT MAP undertakes general contingency planning, actual mitigation of disasters and their effects on the population, establishment of emergency communications and public information systems, and preparation for security and traffic-related problems arising during emergencies. FORT MAP holds one large-scale disaster drill annually followed by a performance evaluation of participants. A review of the system by Alberta Public Safety Services early in 1985 concluded that "local industry should be applauded for developing and subsidizing FORT MAP". The review went on to suggest that in the future FORT MAP may want to place greater emphasis on mutual education and training of members as well as education of Fort Saskatchewan citizens.

In the field of emergency response to chemical transportation incidents, CCPA has had a Transportation Emergency Assistance Plan (TEAP) since 1971. TEAP was the first national system established in North America to offer technical advice at the scene of transportation emergencies and companies provided emergency response teams when they were requested. Early in 1983 TEAP was modified to fully transform the system into an emergency response organization.

TEAP is now a national voluntary mutual assistance service administered by the CCPA to minimize the effects of chemical transportation emergencies on human health, the environment and property. Under contract, if a chemical shipped by a TEAP member company is involved in a transportation emergency, a trained and equipped TEAP team is dispatched to the incident scene upon request by the TEAP member. TEAP functions through 10 (soon to be 11) Regional Response Centres (RRCs) located across Canada (see Appendix III-1) to offer complete coverage 24 hours a day, 7 days a week. Each RRC maintains a team of experienced personnel ready to provide technical advice and assistance. The minimum list of equipment suggested for each RRC appears in Appendix III-2. Each RRC maintains a vehicle for transporting this and other equipment to the emergency scene. Emergency vehicles range from trailers towed by utility vehicles up to large emergency response vans.

To activate TEAP, on-scene officials can telephone the shipper directly or through the Canadian Transportation Emergency Centre (CANUTEC), a public service operated by Transport Canada. The shipper may respond with his own emergency response

team or activate the TEAP system. In the latter event the TEAP RRC closest to the scene will dispatch an emergency team that will make every effort to reach the emergency scene within six hours. At the same time the shipper will send out his own technical advisor. Once these personnel reach the scene their role is to assist and advise the authorities on measures to control the situation. The TEAP team will be relieved by the shipper's own emergency response team within 24 hours if ongoing assistance is required. The CCPA's Board of Directors recently approved an extension of TEAP to non-CCPA companies associated with the chemical industry, providing that these companies are prepared to enter into a formal mutual-aid contract with CCPA.

TEAP is no longer largely an information service since this role has been assumed by CANUTEC, which provides immediate advice by telephone to anyone requesting information in any emergency situation involving dangerous goods in a spill, leak, fire, or incident involving human exposure. This assistance is available 24 hours a day, 7 days a week. CANUTEC and TEAP are complimentary - CANUTEC offers technical information and TEAP offers on-the-scene assistance. Together, they provide those at the scene of a chemical transportation emergency with rapid access to information and professional assistance in dealing with the chemicals involved. In 1983 and 1984 the number of calls upon TEAP totalled only 17, ranging from telephone referrals to the call-out of a TEAP team. This may reflect the rather small number of serious transportation incidents involving CCPA companies.

Another important TEAP activity has been the development of an Emergency Response Assessment with assistance from Esso Chemical Canada. This assessment provides a comprehensive check list of questions and points to be considered in a company's self-assessment of its contingency plan and emergency response arrangements. The assessment is in the final stages of development and so far has been completed by most of the companies operating TEAP Regional Response Centres.

Approximately 25 percent of the industrial chemicals and synthetic resins manufactured in Canada are produced by companies that are not members of CCPA and that may not have agreed to participate in any mutual-aid response plan for chemical accidents involving their products. Transportation in this segment of the industry has been reviewed by the Transport of Dangerous Goods Directorate (TDGD) of Transport Canada. The TDGD requires that a summary of contingency plans be filed if the company does not participate in TEAP or another approved mutual-aid plan. However, as indicated by the question marks in Appendix III-6, we feel that this part of the industry should be

examined in more depth, and that the recommendations described in this report should be applied to non-CCPA companies both for plant-site and transportation situations.

2.1.3 Other Segments of the Chemical Industry.

The Chlorine Industry. As part of a joint response plan by chlorine producers in Canada and the U.S., releases of chlorine in Canada are covered by a special industry plan called the Chlorine Emergency Plan (CHLOREP). This plan is administered by the Chlorine Institute in New York, but is normally activated in Canada through a call to the TEAP network or to Transport Canada's CANUTEC emergency centre. Response teams are located in Canada as part of the CHLOREP network. The plan, dealing solely with chlorine releases, is somewhat like that of a TEAP response plan, in that the responding CHLOREP Team is sent to the incident scene for a limited period of technical advice, assistance to an on-scene commander, or hands-on remedy of the problem. The shipper is expected to relieve the CHLOREP Team as soon as feasible. Standardized repair kits are used to deal with most leak problems arising from various standard sizes of chlorine cylinder, container, tank car and barge.

Hydrogen Fluoride Producers. Several North American manufacturers of hydrogen fluoride, including the single Canadian producer, have established a mutual aid "HF Emergency Response Program" for incidents involving this product. The plan is comparable to the CHLOREP plan described above, and can be triggered by a call to CANUTEC, or the CHEMTREC emergency centre in the United States.

The Specialty Chemicals Industry. A number of smaller specialty chemical suppliers and manufacturers operate plants and warehouses in Canada. These companies deal with smaller quantities of packaged products and would not likely have the potential for a Bhopal-type incident, although many of their products are acutely toxic. A study of their products, exact hazards and potential risks would be appropriate, however, in view of other industries also being examined.

The Pesticide Chemical Industry. One part of the Agricultural Chemicals Industry, represented by the Canadian Agricultural Chemicals Association, deals with pesticides. The primary concern for a Bhopal-type incident in this industry sector is a major fire of pesticides and other associated chemicals that may be present in an agricultural warehouse or transport vehicle. Such an incident could cause health effects in nearby communities, through a combination of toxic smoke plumes and contaminated water runoff. The smoke plume is the primary concern since it may contain a

combination of pesticide vapours, unburnt particles of active ingredient and many poorly characterized but possibly toxic products of chemical combustion. All of these products are carried skyward by the smoke plume's thermal rise, and then dispersed downwind over a wide area.

Contingency plans and response strategies for dealing with pesticide storage fires are somewhat different than for normal fires. General guidance is available through a brochure available from Pesticide Safety Data Distributors of Scarborough, Ontario, although specific advice should also be sought from the supplier, warehouse, operator, provincial agencies and the pesticide information data bank held by Transport Canada's CANUTEC emergency centre.

The Fertilizer Chemical Industry. The other facet of the "agrochemicals industry" is the fertilizer industry. This industry sector deals in large volumes of two chemicals of possible concern for Bhopal-type incidents - anhydrous ammonia and ammonium nitrate, although the primary concern would be for explosive-grade ammonium nitrate, not the fertilizer grade.

There are two response plans in place for anhydrous ammonia incidents in Canada, through the TEAP plan, and through an additional mutual-aid plan of western producers of anhydrous ammonia, under the Western Canada Fertilizer Association. We are not aware of any contingency plan for response to and mitigation of ammonium nitrate explosions. However, an inquiry or a site investigation after any explosion would involve the ammonium nitrate manufacturer, together with provincial authorities, the Explosives Branch inspectors of the Federal Department of Energy, Mines and Resources, or Bureau of Explosives inspectors from the American Association of Railroads, as well as the Canadian Transport Commission if the accident were to occur on a railway.

2.1.4 Other Process Industries. A number of other industries, including the pulp and paper, mining, and manufacturing industries involve companies which use toxic chemicals in their processes or operations, including some of those identified by Working Group 1 as chemicals of specific concern for major incidents. These industries should be examined in greater detail than was possible in this review, for their risk levels and their specific prevention and response capabilities.

The Pulp and Paper Industry. The pulp and paper industry uses large quantities of Bhopal-type chemicals such as chlorine, hydrogen sulphide and sulphur dioxide. Most pulp and paper plants have company contingency plans and trained teams to deal with minor incidents involving these and other chemicals. As customers of major chemical

suppliers, they also have access to mutual aid plans such as the CHLOREP and the TEAP plans for larger incidents.

The Mining Industry. The mining industry's mine rescue teams have an excellent reputation. Based on the nature of some mining industry responses to incidents involving toxic chemicals having potential major consequences (e.g., sodium cyanide), the level of company and industry contingency planning, training and response for incidents may not match the standard set for its rescue teams, particularly for off-site accidents where the plant response team may be many hours away from the spill site. We are aware of a few contingency plans and specially-equipped, trained teams for spill response at the site of mines, mills or smelters. More work by the industry appears necessary to address the questions of off-site releases and the adequacy of plans and response mechanisms for all mining industry companies that handle and use hazardous chemicals.

The Manufacturing Industry. The manufacturing industry is mainly comprised of small companies, most of which do not use toxic chemicals in quantities sufficient to create a Bhopal-type incident. A small proportion of these companies, however, could become involved in a major incident involving release of a significant volume of a toxic chemical of concern. The Canadian Manufacturers Association should survey its member companies to determine the level of risks and the guidance needed and stimulation of contingency planning and response by member companies or mutual-aid systems available from the chemical suppliers. Thereafter, in consultation with appropriate provincial and federal agencies and the chemical industry, it could undertake or guide specific technical projects to improve the level of contingency planning, training and response for member companies in this position.

2.1.5 The Transportation Industries.

The Railway Industry. In Canada, approximately 70 percent of the volume of dangerous goods regulated by the Transportation of Dangerous Goods Act is moved by rail. The frequency of spills due to railroad incidents is reportedly 10 percent of all transportation incidents. However, the volumes released in spills due to railway incidents are a far higher proportion than 10 percent because of the bulk quantities carried in rail cars.

Many railway companies in Canada have developed comprehensive preventative maintenance and emergency programs instituted by the railway industry. These programs have been supplemented through the implementation of the Grange Inquiry recommendations resulting from the Mississauga derailment. Major recommendations

from the Grange Inquiry include the development of speed restrictions for a list of special commodities being moved through populated areas, replacement of convential bearings with roller bearings on freight cars, and coupler and thermal insulation protection on tank cars. The two major railway companies, and Ontario Northland, have each undertaken substantial training programs involving the handling of dangerous goods and emergency responses to incidents involving all types of dangerous goods, community awareness information seminars have been given throughout Canada involving well over 6 000 emergency-force personnel at 260 locations. Specialized response equipment has been strategically located in each railway region with smaller response equipment units operating from smaller centres within the regions.

For example, CN has three "Mobile 1" trailers, three medium-sized trailers, and six smaller "Mobile 3" vans each equipped with sophisticated response equipment (gas detecting instruments, self-contained breathing apparatus, specialized tools to secure emissions), all with fully-trained personnel. CP Rail also has designated emergency personnel from both the transportation and equipment departments of each region trained to respond to emergencies. The emergency mobile vans can serve as a command post, first-aid centre, communication centre, as well as a storage facility for initial response equipment. The vans may be transported either by rail or road.

In event of an accident, the computer systems within the major railway companies have the capability to identify precisely the dangerous goods involved, the car numbers, their location on the train, and what other goods are involved. Legislation covers the management of each trailerload, carload and containerload of dangerous goods. An emergency response form indicating the potential hazards, course of initial response action to be taken, and first-aid measures must accompany the shipment throughout its journey.

There are limitations, however, on the types and size of incidents that can be managed by the existing response plans and the current equipment inventories. Government agencies could assist the railways in a review of countermeasures capability.

The Trucking Industry. The trucking industry has a greater accident:tonnage ratio than the railway industry, however, this industry has recently accelerated its efforts for contingency planning and spill response training in order to comply with regulations under the Transportation of Dangerous Goods Act. Considerable progress has been made, although the training for some carriers has been rushed and may not be retained by participants unless followed by annual hands-on exercises and periodic refresher training. A number of major trucking companies, especially bulk chemical carriers, have their own

company response plans, and some capability to deal with incidents near their branch offices. Others must rely on response/cleanup contractors and the TEAP system of the chemical industry for most of their responses involving products of suppliers participating in TEAP. Only a small proportion of the drivers, warehouse personnel and other handlers/transporters of dangerous goods, who have received such training, are likely to be dealing with the larger quantities of the chemicals of concern for major accidents. Nevertheless, in view of the substantial movement of bulk chemicals by truck, this industry should be examined more closely for its risk potential and its prevention and response programs for major chemical accidents.

The chemical industry has a policy of responsible care for its primary transport companies and major chemical customers. This policy covers both prevention and readiness phases of chemical spills. A logical extension of "responsible care" would be to require periodic extended emergency response training for truckers and shipping/receiving personnel who handle Bhopal-type chemicals in large quantities.

The Marine/Shipping Industry. There is a substantial movement of dangerous goods through most major ports in Canada, both in the form of petroleum products, and chemicals in bulk and in containers. A very small portion of this volume of dangerous goods involves the type of toxic chemicals of concern in this report. Some work in assessing these movements has been done by government agencies. However, container terminals and the ports covered by the Canada Ports Corporation should be examined in greater detail for risk prevention and preparedness programs.

Since the shipping industry is international and vessels have limited direct access to contractors with marine clean-up equipment, the response to spill incidents from ships is largely the responsibility of a national government agency having an operational capability for marine activities (e.g., Coast Guard, Navy, etc.). In Canada, under the Canada Shipping Act and the Arctic Waters Pollution Prevention Act (as well as by custom, precedent and certain international agreements) the Canadian Coast Guard has responsibility for monitoring the effectiveness of the polluter's response to spills of oil or noxious substances. The Coast Guard has an extensive inventory of approximately $34 million worth of oil spill response equipment and specialized vessels. A Coast Guard spill response is normally made as an agency of "last resort" after all commercial and industrial response mechanisms have been exhausted.

We must emphasize, however, that there is currently very little response capability in place in industry or government for ship spills involving any products other

than crude oils and petroleum fuels. The frequency of incidents involving spills of other hazardous materials from ships in Canada has historically been about seven per year, based on Coast Guard accident statistics. Informally, however, regional Coast Guard offices receive about 40 to 50 reports/inquiries per year about hazardous material cargo problems; more definite statistics on the frequency and nature of hazardous material spills in ports from ships may become available now that mandatory reporting is required under Transportation of Dangerous Goods Regulations.

Most of the accident prevention work for vessels is conducted by international organizations such as IMO, the International Maritime Organization, and UNEP, the United Nations Environmental Program. There is unfortunately no chemical ship owners' mutual-aid emergency response plan equivalent to that operated for oil spills by the International Tanker Owners Pollution Federation. The Canadian Coast Guard should undertake an industry review of potential Bhopal-type incidents involving the shipping industry in Canada. Consultation with relevant industry associations, government agencies and Ports Canada would be appropriate.

The Air Transport Industry. A major incident is not considered likely in the air transport industry because of the relatively small volumes carried and the additional restrictions on air transportation of dangerous goods developed by the International Civil Aviation Organization (ICAO). However, a scenario involving the dumping or crash of a pesticide spray plane into a municipal water supply has already occurred in Canada, but was fortunately detected before serious health effects arose. The municipal or provincial emergency measures plan, supplemented by response from provincial health, agriculture and environment officials, the agricultural chemical supplier and CANUTEC would likely be involved.

2.2 Governments

2.2.1 General Emergency Preparedness. The network of emergency response systems for chemical spills can vary considerably in different parts of Canada. The relationships between industrial, municipal, provincial/territorial and federal levels follow general patterns, with small adjustments apparent for individual locations. The general relationships are shown in Appendix III-4, but readers are advised to consult contingency planning agencies in their area.

Presentation of an overview of the relative "readiness" of companies, industries and various levels of government in Canada for potential major chemical incidents has been an objective of Working Group 3. A questionnaire (Appendix III-5) was

circulated to provincial and territorial emergency agencies through Emergency Planning Canada. While acknowledging that the survey would not be a definitive assessment, we tried to minimize subjectivity in designing the questions. The lack of any detailed information on these subjects at the provincial level did result in "informed opinions". The responses show a range of levels of preparedness for major chemical accidents, with some correlation, as expected, between the perceived level of risk and the levels of readiness judged to exist in each jurisdiction. The comments received indicate that the respondants agree that the levels of readiness for chemical accidents should be improved.

Several elements of general emergency preparedness are particularly relevant to contingency planning by governments for Bhopal-type incidents in Canada. Advances could be made in both prevention and government readiness for major chemical accidents if further work was undertaken by provincial and federal agencies in areas such as the following.

(a) **Hazard Analysis.** Both risk assessment and hazard analysis have been applied in emergency prevention and contingency planning projects in Canada. For emergency preparedness purposes, we believe hazard analysis is more useful. It is widely used internationally by the chemical industry. Many larger Canadian chemical companies have used it for years. However, there is a shortage of consistant and concise guidance about the application of contemporary hazard analysis techniques across Canada. Hazard identification and analysis is one of the primary steps in emergency prevention and preparedness development. It is essential that this be conducted in all industries and by all levels of government using the best available systems.

(b) **Assessment of Response Capability.** A preparedness capability is more than the sum of its specialist parts such as police, fire and medical services. However, an examination of disaster responses has repeatedly identified shortcomings that cannot be attributed to any one specialist agency. Rather, they are shortcomings of the total system of response. A recurring requirement at all levels of government is to provide data, options, judgements or assessments on emergency preparedness for numerous reasons. The Bhopal Aftermath Review is simply one more reason. However, it has become evident to Working Group 3 that there appears to be no common base for collection of data on preparedness, and no established measureable units or criteria on which to make objective evaluations. Some provincial agencies have been considering this need within their own organizations. There appears to be a concensus among the emergency planners that a systematic process of collecting

and evaluating data on preparedness is essential. Such an assessment system should be developed and applied across Canada if it is shown to be feasible.

(c) **Public Warning.** Improved methods of public warning are sorely needed, even though research abounds on the requirements for public warning in emergencies. These requirements must be stringently met in the event of a sudden toxic chemical release. A warning system must be customized to local situations; provide full coverage for the entire area of potential risk; be delivered within the time available for response; and be intelligible. Experience has shown that a warning that is not intelligible or instructive is no warning at all. A clear understanding is needed of the responsibilities for designing the warning system, installing equipment, educating the public, predicting the path and concentrations of an actual release, preparing the public warning and instructions, activating the warning system and delivering the warning and instructions to the public. Provinces, territories and municipalities could address these needs through municipal-provincial coordination groups for emergency preparedness and response, with federal support.

(d) **The Profession of Emergency Preparedness.** Often, emergency coordinators or planners in government agencies are selected because of experience in a single technical or service area such as police, fire, military, environmental management or medical care. Occasionally they are selected for other reasons. Nevertheless, once they are selected, their further development is usually one of accident or individual pursuit. There is no systematic approach to developing those employed as general planners/coordinators/managers of emergency systems in government. There is a need to put into place a professional development program for generalist emergency planners and managers, including an examination of the merits of certification or degrees of qualification, and the development of suitable career-development materials and milestones. This could be a joint federal-provincial project, with input from industrial and municipal emergency planners.

2.2.2 Government Systems for Emergencies

Municipal. The level of government most immediately and directly affected by a major toxic chemical release in an urban area is the municipal government. It has primary responsibility for an initial response by elected officials, fire, police and other emergency services to assess the danger, protect threatened populations, take steps to contain or mitigate the problem where confident and safe to do so (e.g., fight fire, use

water spray barrier or foam), control crowds and traffic, and take command of the response operation for public safety when necessary. As an accident escalates in magnitude, the command of operations may shift from municipal governments to provincial, although the latter transfer occurs only under unusual circumstances. A Bhopal-type incident is probably one of these unusual circumstances.

Other local agencies and services that would be involved in major chemical incidents include elected officials, emergency medical clinics, hospitals, poison control centres, public works, social services for emergency accommodation, clothing and feeding, and other welfare services. The involvement of all these agencies in an integrated, coordinated fashion requires municipal-level contingency plans. These plans normally cover a wide variety of potential emergencies, of which a Bhopal-type incident would be one example.

Provincial/Territorial. Numerous provincial/territorial departments and agencies form the main backup resources for support and, if necessary, control of the government responses, in case the resources of the municipal response plan are exceeded. Such an escalation of government involvement is assumed for a Bhopal-type disaster. These are also the primary response agencies for incidents occurring in rural areas. Among these agencies and their roles are the following typical examples:

(a) **Emergency Measures Agency:** Coordinates overall contingency planning and response in support of, or on behalf of, a municipality, rural area or provincial/territorial lands; operates a provincial alerting network with local police and other agencies; controls supplemental emergency resources; recommends declaration of emergency to appropriate agency; operates provincial command centre(s); controls records and costs.

(b) **Solicitor General (RCMP or provincial police):** Provides control of access to accident site; supplements local police forces; assists or conducts public evacuation; maintains security of evacuated rural areas.

(c) **Environment Agency:** Provides monitoring and advisory support to response team for environmental concerns and technological problems/solutions; relays any initial accident reports to local police and provincial emergency measures agency; provides other specialized support such as lab analysis; may provide trained equipped response team for monitoring or site cleanup.

(d) **Natural Resources Department:** Provides logistical support, communications and other resources; may be primary regulatory agency for prevention and cleanup of chemical emergency (e.g., sour gas well blowouts); may also control and provide some temporary accommodation.

(e) **Transportation Department:** Provides specialized equipment on request; constructs special access routes; assists with communications equipment.

(f) **Communications Department:** Provides or arranges emergency communications; may operate communications network.

(g) **Hospitals and Ambulance Agency:** Ensures required treatment and care services are maintained for hospitals; arranges supplementary ambulance support.

(h) **Health and Social Services Department:** Maintains inventory and access for supplementary resources for health care and social services; handles many support services following evacuation.

(i) **Public Works and Housing:** Locates and provides temporary shelter; provides special vehicles and equipment if appropriate.

(j) **Others** include Agriculture, Attorney General, Treasury, Labour and similar agencies.

Federal. A number of federal departments and agencies are responsible for contingency plans, response or support in chemical emergencies. Some incidents would fall under federal responsibility for direct response or monitoring.

(a) **Transport Canada/TDG.** Operates CANUTEC Emergency Information Centre; regulates multi-modal transport of dangerous goods (except highways, bulk vessels and pipelines); requires shippers, importers and handlers to have contingency plans and response arrangements; provides inspectors at scene of transportation accidents, when required.

(b) **Transport Canada/Canadian Coast Guard.** Monitors response activities at the scene of vessel spills; when required and feasible responds to certain pollution incidents with large inventory of specialized equipment and vessels; is currently reviewing its future role in chemical incidents.

(c) **Canadian Transport Commission/RTC.** Responds to railway derailments with regional inspectors (particularly when dangerous goods are involved); provides

guidance or issues orders for railroad and shipper response activities on railway right-of-way; and cooperates with local and provincial response organizations.

(d) **Environment Canada.** Provides weather and trajectory modelling information on request; monitors environmental damage and technical cleanup activities for incidents of federal responsibility; provides general technical guidance on spill contingency planning, response training and countermeasures; evaluates and develops new spill technology; publishes technical reports and manuals on chemical and oil spills; manages national environmental emergency program.

(e) **Health and Welfare Canada.** Provides emergency health and welfare support and advisory services to provinces; develops and conducts training courses on emergency health and welfare management for all levels of government; acts as lead federal contact for emergency health and welfare matters.

(f) **Emergency Planning Canada.** Acts as the primary federal agency for the coordination of emergency planning, training and operational assistance in support of the provinces, territories and other federal departments having responsibilities for specific response functions in emergencies, including chemical accidents; arranges supplementary federal resources when requested by a province; supports provincial and local emergency preparedness initiatives through Joint Emergency Preparedness Program (JEPP) funds.

(g) **Other Departments and Agencies.** Others such as Agriculture, Defence, Employment and Immigration, Revenue/Customs, Fisheries and Oceans, Indian and Northern Affairs, RCMP, Public Works, Labour, Canada Ports Corporation, and the Canadian Centre for Occupational Health and Safety, may become involved in support activities for certain types of incident, or in special areas of expertise.

International/Bilateral. Through the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), the United Nations Emergency Program (UNEP), the World Health Organization (WHO), and others, significant international programs are underway for prevention and contingency planning for chemical accidents. These are primarily intended for the international aviation and shipping industries, or for developing countries.

Between the U.S. and Canada, a joint Canada-U.S. Marine Pollution Contingency Plan covers cooperative actions by Canadian and U.S. Coast Guards for vessel pollution incidents affecting boundary waters. The U.S. Coast Guard operates three strike

teams with specialized equipment and training in hazardous chemical accident response. The Canadian Coast Guard is reviewing their capabilities in this area.

Another joint Canada-U.S. response plan to address all boundary areas not covered in the marine plan is being developed by the U.S. Environmental Protection Agency and Environment Canada's Environmental Protection Service in consultation with affected states and provinces. On the Canadian side, it will rely heavily on the existing response plans within the provinces and in industry.

3 OTHER DISCUSSION TOPICS

3.1 "Good Samaritan" Protection

This subject is a difficult and contentious area. Readers are advised to seek legal counsel for more specific information.

The concept of voluntary "third party" assistance or intervention at the scene of an emergency is often referred to as the action of "Good Samaritans". For industrial accidents involving hazardous chemicals, some concern may be associated with the legal position and liability protection of third parties who assist authorities or the participants in the emergency response or clean-up, even though these volunteers have no responsibility for having caused or been involved in an incident (the "first" and "second" parties, respectively).

In Canada, civil or "tort law" falls under provincial jurisdiction, including the subject of "Good Samaritan" legislation. There are only a few specific "Good Samaritan Acts" and their protection for "third party" helpers is restricted to the provision of emergency medical aid administered at the accident site. At the same time, there is little legislation in Canada that creates a "duty" for third parties to go to the aid of people involved in an accident, even if these parties have a capability to help and are in a position to help. Therefore, under most current laws in Canada, third parties are not required to offer help, and cannot be prosecuted for failing to provide such aid.

Liability protection is provided under certain provincial statutes to third parties who act under the direction (written or verbal) of a minister or officials in a declared emergency situation, or in a situation where another Act (e.g., Environmental Protection, Forestry Protection) specifically provides liability protection for the minister, and officials and persons acting under their direction.

If, however, a "Good Samaritan" decides to provide assistance to someone other than a minister or official who may "direct" them and provide liability protection, the volunteer helper should then ensure that such actions:

(a) fall strictly within his/her areas of knowledge and competence; and
(b) cover everything within these areas of competence that any reasonably competent person would be expected to do under the circumstances.

Failure to meet these requirements may mean this volunteer could be subject to claims of liability for actions incorrectly taken and for actions not taken within the area of their competence. However, some lawyers believe that precedents in common law tend to

protect well-meaning volunteers who provide help to the best of their ability. Only for cases where gross negligence may be involved would such voluntary assistance likely be challenged in Canadian courts. Despite this view, many companies include a "hold harmless" provision in their contracts for emergency response.

In summary, the protection of the "Good Samaritan" at Canadian accidents is understood to be as follows:

(a) if a third party had a duty in law to assist, and did everything reasonable to assist, there would be no liability incurred; however,

(b) if, as is currently the situation in most parts of Canada, a third party has no duty in law to assist, and does nothing, there can be no prosecution or liability for failing to assist;

(c) protection against liability for "Good Samaritans" exists if they cease to be volunteers and act under the direction (written or verbal) of a minister or his officials, provided that they in turn are acting under declared emergency conditions or under protective provisions of other specific acts; and

(d) if, despite there being no duty to assist, the third party volunteers to assist someone other than an official having statutory protection against liability, then such a "Good Samaritan" may be vulnerable to liability claims but likely only if his actions can be challenged as negligent.

On behalf of the provinces, and at the request of the federal Minister of Justice, the Federal Law Reform Commission is currently examining such questions as duties and liability protection for the third party actions at the scene of an accident, including actions to rescue people in immediate danger, and to mitigate damage caused by the accident.

3.2 Community Awareness and Contingency Planning

Communities must deal with a variety of possible emergencies, including those of a natural and technological nature. Many municipalities address this problem through an integrated plan with fire, police and emergency medical services as the primary agencies involved. The local emergency organization must be concerned about hazardous chemicals stored or passing through their communities, since they will be responsible for dealing with their citizens safety and disaster needs. The initial response to an incident is normally provided by a local agency (fire or police); the nature of that response can greatly affect the eventual outcome and magnitude of the incident. An up-to-date community plan for orderly evacuation of threatened areas is essential.

In many recent chemical emergencies occurring around the world, one of the most consistent shortcomings identified after the events were over has been the lack of both an awareness by municipal officials and the citizens as to the hazard that a chemical emergency could pose for their safety, and of a comprehensive, publicized plan for their possible evacuation.

Both of the mutual aid systems discussed in Section 2.1.2 include community organizations, so that integration of the industry and community emergency plans is assured in those examples. The degree to which individual chemical companies have made local communities aware of their plans and helped integrate the plans into those of the community probably varies. It must be remembered, however, that this is a two-way street. The community should be prepared to devote the resources necessary to develop a community plan if it is needed and work with local organizations to consider integration of their individual plans. The CCPA survey demonstrated that a number of companies have already fully integrated their plans into those of the local community. Other companies mentioned their extensive commitment to community outreach and liaison measures. Over the past few years many companies have improved their liaison with local fire departments in particular. Other CCPA companies have identified this as an area where they will be seeking improvement in the future.

The CCPA safety assessment and responsible care programs will each assist chemical companies in achieving improvements in working with the local community. The safety assessment program specifically addresses communications with the community. The CCPA also intends to develop a responsible care practice called "Working with the Community and the Public". This practice will implement the CCPA's responsible care principle that its companies will "be responsive and sensitive to legitimate community concerns". In preparing programs for its members in this area, CCPA will be assisted by the "Community Awareness and Emergency Response" (CAER) program developed by the U.S. Chemical Manufacturers' Association. This program encourages ongoing communication and mutually supportive contingency planning between industry and the commnunity for incidents that affect the general public. A Canadian program incorporating the principles of CAER for both chemical producers and major chemical users should improve the current state of response capabilities in communities where dangerous chemicals are manufactured or used.

In general, joint preparedness and communications by an industry and the community may involve activities such as:

(a) joint meetings of industry and community officials to share information on joint disaster planning and the particular chemicals of concern;
(b) the joint conduct of hazard assessments;
(c) the development of mutually-supportive contingency plans for the industrial and community organizations, including early public warning, on-going emergency consultations and information, and the linkages between the industry and community plan;
(d) formal agreements for mutual aid and common understanding of roles/actions;
(e) training courses, information brochures and public education materials;
(f) public meetings to discuss the plans; and
(g) disaster simulations and emergency response exercises.

Problems that can arise include apathy ("it cannot happen here"), over-confidence ("a plan on the shelf means we are ready") and cost concerns ("we cannot afford the plan"). These can be overcome by frank and open dialogue with the public, an ongoing commitment to public safety management and an assurance that the moderate costs of preparation are worth the effort to avoid the disastrous and costly problems when caught unprepared.

A variety of industry and community representatives have expressed a renewed commitment, at least in some progressive communities, to develop community awareness and contingency planning. Oil and chemical industry programs, actions by some railroad companies in meeting with communities on their routes, and stronger encouragement and guidance by provincial governments are some examples. Public awareness is a critically important prerequisite of readiness for Bhopal-type incidents and must be stressed to all communities in the nation where such accidents could possibly occur.

3.3 Emergency Medical Services

The greatest impact of a major chemical accident that affects a sizeable population will be on the portion of the public exposed and on the medical services community which will have to deal with mass casualty treatment. As health protection is a provincial matter, the majority of the response systems to deal with disasters from a health perspective are at the community or provincial level. The federal role is largely one of provision of support, guidance and advice when requested.

3.3.1 Community Level. The medical components are important factors in most community incident response plans. Hospitals, most of which have their own disaster plans, are an integral part of this component. Many hospitals, particularly those in major cities, have poison control or toxicology centres which have to be prepared for a major chemical accident. Universities and medical schools are also valuable community-level resources.

3.3.2 Provincial Level. Ambulance services are controlled and licensed by most provincial governments, although they are community-based. The health sciences sections of universities, particularly those with medical schools, may have toxicologists or biochemists who may be of assistance. As well, many provincial laboratory directors may be able to provide assistance.

3.3.3 Federal Level. The federal response is coordinated through Health and Welfare Canada. The Emergency Services Division, Medical Services Branch, is responsible for assistance and advice to provinces and municipalities in emergency health services planning, including the provision of emergency medical units to augment existing resources in the event of a disaster. In addition, they produce, conduct and direct emergency services courses including a Community Emergency Planning (Health) Course.

Within the Health Protection Branch a number of resources could be utilized in a Bhopal-like incident. The Environmental Health Directorate includes the Bureau of Chemical Hazards which is engaged in a wide ranging program of research and assessment on chemical contaminants and therefore may be able to offer pertinent advice. Laboratories which may be able to assist in analysis are available. In addition, there are toxicologists, biochemists and other professionals who may be able to offer guidance and advice.

3.3.4 Further Studies. Training and planning aspects of mass casualty care should be reviewed. Prior planning, training and drills are the key ingredients for adequate care of disaster victims. As was implied above, most local and provincial authorities have general contingency plans for treatment of mass casualties and for coordination of emergency medical services, regardless of the type of accident. These plans would certainly be applied in a Bhopal-type incident in terms of general emergency medical service worker coordination and procedures (e.g., field triage, treatment for burns, injuries and cuts, removal to hospital facilities and further treatment) for major fires or explosions. In cases of mass casualty treatment for toxic gas or vapour releases involving some of the

Bhopal-type chemicals, the protocols would probably need to be adjusted. Some of the problem areas where more work or preparation may be required include:

(a) special or additional training of both professional and volunteer workers in chemical incident response;
(b) protection of field workers during removal of victims from the contaminated accident site;
(c) sampling and identification of chemical or contamination products to ensure proper medical treatment;
(d) decontamination procedures and equipment for victims of chemical accidents;
(e) symptom interpretation and triage decisions by medical professionals for Bhopal-type chemicals;
(f) knowledge of chemical toxicology and treatment protocols, and adequacy of references in poison control centres and hospitals; and
(g) availability of medical supplies for chemical antidotes .

To address these needs, better mass casualty treatment systems and plans, further surveys/research and a network for information exchange could be considered. Experience gained by emergency medical professionals in incidents involving chemicals could be gathered and assessed, together with information on short-term chemical exposure symptoms and treatment. The current information is mainly based on pharmaceutical products, household poisons and drugs, but industrial chemicals are not yet covered completely.

Existing federal-provincial consultation groups and professional advisory bodies having emergency medical expertise could undertake or coordinate the tasks listed above.

3.4 On-Scene Coordination of Response

Occasionally, coordination problems can arise at the scene of emergency incidents. Such difficulties can be serious when time is critical and appropriate team-work actions must be taken. Examples of such problems are:

(a) absence of a unified command structure;
(b) gaps or duplications in alerting or in other response activities such as monitoring and advisory support;
(c) uncoordinated resources, communications support groups, or uncontrolled site access;

(d) conflicting advice to emergency managers or conflicting public/media information;

(e) no identification of key personnel and a command centre; or

(f) some combination of the above problems.

Effective contingency planning and communication among responders beforehand, combined with application of the principle of unity of command can avoid these problems. In emergency operations, there can be only one boss, responsible for overall response coordination. This person is often called the On-Scene Commander or On-Scene Coordinator, or simply the OSC. Normally, the authority having jurisdiction over the area or location of the incident is in charge of any major emergency situation. Local or provincial govenment authorities charged with such responsibilities usually approach the problem of chemical emergency response as one of a series of natural and man-made emergencies for which they must be ready. In such an integrated emergency management system, all the participants know the command control and communication structure in place. Adjustments can be made by the response team to account for variations in the type of emergency, but the essential element is that a response plan and the relationships between the players are established and understood beforehand. If, on the other hand, a specialist agency is given the responsibility for organizing the response, then all the potential response groups must have met and worked out in detail the operational, advisory and support functions for that specific type of response. Integration of groups having such plans for different types of emergencies must then be clear beforehand, through a series of meetings, agreements and exercises.

In chemical emergencies, where technical information and advice is critical, the support groups must know the sources of information, determine and resolve any conflicting information and make consensus recommendations to the person in charge. One specialist or the On-Scene Commander should be designated to deal with the media, and make information available to the public, meeting with the press at specified times, preferably in some location away from the operations centre. Press releases should be developed with appropriate input from line and support functions, and should be cleared for release only through the same specialist or the OSC.

Visible identification of the OSC and the command post is often made through a distinctively coloured and marked vest or safety hat, and by raising a flag marked "C.P." at the location of the command post.

In summary, coordination problems are solved through good planning and discussion beforehand, and through a team-work approach under a unified command structure at the time of the response.

3.5 Spill Response Training

Introductory or basic-level training for emergency prevention and initial response by smaller companies, including those in a number of industries using, handling or transporting dangerous goods, has been accelerating recently, with the enactment of Transportation of Dangerous Goods regulations effective July 1, 1985. Since 1973, some provincial and federal agencies, and many of the larger companies in the petroleum and chemical industries have been presenting both classroom courses and "hands-on" training for key emergency response personnel. Provincial emergency measures agencies and their federal counterpart, Emergency Planning Canada, have been teaching courses on disaster management and various other emergency topics for many years. The Canadian Coast Guard has recently developed and presented a comprehensive 15-day course in Marine Emergency Management. There are also several different advisory or working groups examining needs for training courses and materials for emergency spill response.

Some of the specific efforts in training for spills countermeasures and other emergency response are given below. One can conclude, looking at this list, that there is still a shortage of hands-on training for hazardous chemical spills, especially for response to larger accidents, but some of the groups mentioned at the end of this discussion are working on this problem.

3.5.1 The Petroleum Industry. Over the years, the petroleum industry has undertaken:

(a) in-house transport of dangerous goods and spill response courses/exercises for company personnel;

(b) mutual-aid exercises and hands-on training for employees of participating companies and for contracted response personnel;

(c) various Petroleum Industry Training Service courses in Western Canada;

(d) hands-on training for oil spill response at Lambton College, Sarnia;

(e) periodic workshops/exercises on specific topics or countermeasures techniques, such as On-scene Command, winter river boom development, dispersant application and dispersant decision-making; and,

(f) the development of a series of training modules for oil spill response through the Petroleum Association for the Conservation of the Canadian Environment (PACE), in cooperation with the Canadian Petroleum Association, its regional affiliates and several government agencies. The group has recently begun to look at training

needs for spill response for other hazardous materials handled in the petroleum industry.

Part of the above training is applicable to response training for major chemical accidents in terms of emergency management principles, but is mainly focussed on dealing with small to medium-sized petroleum spills.

3.5.2 **The Chemical Industry.** Although on-scene emergency assistance is TEAP's primary role, it also undertakes many other activities. For example, TEAP personnel actively assisted Transport Canada during its establishment of CANUTEC and helped to train CANUTEC employees in effectively responding to requests for information. The Canadian Chemical Producers Association, through its TEAP organization, has become a leader in training for transportation emergency response in Canada. TEAP has held five chemical transportation emergency response seminars across the country since 1980. The seminars have attracted a broad audience in addition to industry personnel, including representatives from fire and police departments as well as many federal and provincial government departments and agencies. Some of these seminars have offered hands-on training for transportation emergency procedures. Others have provided a comprehensive approach to emergency planning needs, the initial response to the incident, a disciplined approach to the incident and media training. The TEAP organization is now video taping training modules to make them more widely available across Canada.

TEAP has been particularly active in further developing and promoting the adoption of a "disciplined approach" in Canada (Appendix III-3). It offers a disciplined process for making decisions during a dangerous goods incident. A person familiar with this approach can list and work with the factors that need to be considered in sizing up a dangerous goods incident. It also offers a process for determining both preventive and corrective actions that should be taken at the incident scene. The CCPA has prepared a course on this subject that will soon be offered in Ontario by Lambton College.

Some members of chemical company emergency response teams have undertaken advanced spill response courses for hazardous materials such as those offered in the U.S. at Texas A&M University, or by the American Association of Railroads in Colorado. Some of the multi-national companies have also provided advanced hands-on chemical emergency response training for Canadian employees at locations outside Canada. Lambton College, Sarnia, has developed hands-on training courses for hazardous-material spill response, in cooperation with the local mutual aid cooperative Chemical Valley Emergency Control Organization (CVECO). Periodically, the mutual aid groups in the

chemical industry, such as CVECO in Sarnia and FORT MAP in Fort Saskatchewan, hold exercises or drills which may involve a medium-sized incident (the general approach taken is to look at major incident scenarios and scale them down to more manageable proportions for an exercise). However, there appears to be a need in the chemical industry in other parts of the country for more advanced training for management of medium and major incidents. This should be undertaken in cooperation with local and provincial authorities responsible for emergency measures in the area.

3.5.3 Other Industries. Most other industries undertake only a basic level of dangerous goods response training if they are involved in handling, offering or transporting dangerous goods prescribed under Schedule XII - Part II of the Transportation of Dangerous Goods Regulations. Companies dealing with specific toxic chemicals (e.g., a major user of chlorine in the pulp and paper industry) may have provided extra training in emergency response to their plant employees for minor incidents involving those chemicals, but few companies have extended this training to a major accident scenario. Several private consultants, mainly from the U.S.A., have conducted hands-on training in major cities primarily for fire fighters and laboratory personnel and for people facing small to medium-sized spills of hazardous materials.

3.5.4 Local Governments. Fire and police personnel are often first on-scene to deal with the initial response to an accident involving hazardous chemicals. All have received basic training in general emergency management principles; some of them have begun taking or presenting "initial responder" courses, some of which were first offered by the provincial governments, industry or various provincial or federal agencies. Some first-response courses have also been developed by municipal agencies on their own. In addition to fire and police officers, ambulance, hospital and emergency measures staff may have taken these courses as well. However, the proportion of such people and volunteer fire fighters who have completed initial response training for hazardous materials is still quite low. Where practice exercises have taken place, the local emergency drills usually involve a cooperative response scenario between local municipal officers, industry personnel and supporting provincial groups.

One of the concerns about the local emergency manager's level of training is that additional courses and hands-on training may be needed to eliminate either over-confidence or a lack of confidence in responding to such incidents. More advanced courses for these local responders are being developed, but greater priority and funding is needed for training this key first level of response.

3.5.5 Provincial/Territorial Governments. Some provinces and territories have been active for several years in the training of initial responders for spills and releases. With the passage of provincial legislation for the highway transport of dangerous goods, this training level has risen to cover inspectors and municipal emergency officers. Provincial environment departments, transport departments and emergency measures agencies have been involved in these efforts, along with provincial enforcement agencies. Occasionally, one agency will develop a specific instructional course for their own employees (e.g., Ontario Provincial Police are developing materials for first-responder training of their personnel). Provincial training courses also cover medical and social services during major emergencies. The availability and depth of advanced courses is improving rapidly in some provinces, and more slowly in others. Transfers of course material to these provinces could accelerate training, and such transfers have started to take place among some of the provinces.

3.5.6 Federal Government Agencies. Several federal agencies have developed and presented training courses for certain aspects of spill emergency response. The Transport of Dangerous Goods Directorate of Transport Canada has touched briefly on this subject as part of their TDG awareness seminars at Arnprior, Ontario, with support from other agencies and industry participants. In various regions of the country, regional and district offices of Environment Canada have presented information sessions and training courses on spill response for oil and hazardous materials. Environment Canada also sponsors the annual Technical Seminar on Chemical Spills. Many regional Environmental Protection Service officers have also received advanced training in hazardous materials spill response, and are equipped for monitoring and sampling purposes, with personal protective gear and instrumentation. As previously mentioned, the Canadian Coast Guard has also presented a 15-day course on Major Marine Emergency Management for its regional response staff, other agencies, industry, and some foreign governments. Many aspects of emergency public welfare services that should be addressed in community contingency plans are the subject of federal training programs. Services required include registration and inquiry, lodging, food, clothing and personal services. As well, the long-term psychological aspects of disasters should be addressed in more depth. Training in these services is provided by Health and Welfare Canada in a Community Emergency Planning (Social Services) course conducted at the Canadian Emergency Preparedness College at Arnprior. Emergency medical planning is also covered by a comparable course titled "Emergency Health Services Planning - Community" at the same college. This college is

run by Emergency Planning Canada and offers a comprehensive list of courses for trainers, territorial/provincial and federal government workers, elected and appointed municipal officials and various private sector representatives. Other typical courses at Arnprior which are relevant to major chemical incident training include courses on disaster-site management, on-scene command, exercise design and peacetime emergency planning. Agencies that could become involved in hazardous chemical accidents should consider their needs and begin to develop the required training.

3.5.7 Training Advisory Groups. Among the groups that are known to be examining the needs, content and application of spill emergency training are:

(a) an ad-hoc federal-provincial group examining future needs and developing basic and advanced course materials for dangerous goods emergency training, led by Emergency Planning Canada and Alberta Public Safety Services;

(b) a sub-committee of the (industrial) Advisory Council on the Transportation of Dangerous Goods, reporting through the Inspector-General for Transportation Safety to the Federal Minister of Transport;

(c) a federal-provincial working group examining response training for spills of hazardous wastes (e.g., PCBs) reporting to the Canadian Council of Resource and Environment Ministers (CCREM) and led by the Ontario Ministry of the Environment;

(d) a training sub-committee of the Spill Response Division of PACE (Petroleum Association for Conservation of the Canadian Environment) developing training materials for first responders to hazardous product spills in the petroleum industry; and

(e) a recent meeting of federal-provincial-industrial officials at one of a series of seminars held every other year to discuss training and education for "Peacetime Emergency Preparedness". The participants examined needs for training in a wide variety of emergencies, including major chemical releases. Emergency Planning Canada coordinated the seminar, which also had participation from several other industrialized countries.

There is likely some overlap of activity among these groups and others that may exist. A greater communication amongst the groups and with industry associations could minimize duplication and enhance the development of mutually-supportive training materials for chemical spill response and disaster management.

3.6 Technical Information Needs

Several needed technical studies relating to emergency medicine were outlined in Section 3.3. There are, however, additional technical questions that must be addressed in the areas of public protection measures for major chemical accidents.

There must be a knowledge of what concentrations or levels of chemical contamination are of concern for public safety, leading to pre-established concentration thresholds for decisions on (a) recommended or mandatory evacuation or on (b) recommendations to remain indoors with air intakes closed. Considerable information is available for many industrial chemicals on occupational health and safety standards for chemical exposure, such as threshold limit values (TLV's) and levels posing an "immediate danger to life and health" (IDLH). There is no simple correlation between these workplace values for employees, and the levels at which evacuation of a threatened area would be recommended for either the general public, or for particularly sensitive individuals (children, seniors and people with respiratory problems). Studies should be conducted by a suitable federal/provincial working group, with input from medical and toxicological professionals, to evaluate existing data and to determine and publish recommended evacuation levels for both the general public and for special-need groups. This information should be made available to community and industrial emergency planners.

Another question involves the merits of evacuation versus staying indoors with air intakes sealed off. Under certain circumstances where the release is a "puff" or a moving, well defined cloud, it may be safer to stay indoors and not evacuate. Such situations and specific chemicals must be examined closely, and the results distributed to local emergency officials. Research sponsored by the Alberta government at the University of Alberta has already showed progress in this field. A joint federal/provincial industry committee should address the studies.

3.7 Spill Technology Research and Development

In addressing its needs for spill countermeasures technology development, the petroleum industry has been fortunate that the greater proportion of spilled petroleum products and crude oils behave in a similar manner (i.e., most are flammable and float on water). In addition, few are Bhopal-type chemicals. Therefore, both the behaviour of spilled products and the principles of treatment or recovery have been relatively well understood. The net result of this favourable situation, and of much hard work and investment by both industry and government, has been the development of advanced oil

spill countermeasures technology, and the wide availability and application of both basic and advanced hardware and techniques. Some limitations do exist, however, in the technology for counteracting gas releases such as hydrogen sulphide, sulphur dioxide, propane and natural gas.

The various chemical industries produce a wide range of hazardous chemicals, including a number having the potential for a major incident. The physical and chemical properties of hazardous chemicals in general vary widely, from highly dispersive toxic gases which may be lighter or heavier than air, soluble or insoluble in water, and flammable, less flammable or non-flammable. Hazardous liquids may float on water or sink in water, be miscible or reactive with water or non-miscible/non-reactive with water, as well as flammable, less flammable or non-flammable. Hazardous solids exhibit similar variations in behavioural properties.

Because of the diversity of hazardous chemicals, currently available technology for mitigating the effects of their releases is limited. The chemical industry could benefit from the approach taken over 10 years ago by the petroleum industry to advance the state of cleanup technology on a cooperative basis. Much of the rather rudimentary chemical emergency response equipment in use has been around for 15-20 years, although a few technical breakthroughs have been made in the last few years, such as inflatable air bags and prototype portable reverse osmosis units.

A recent survey by Environment Canada of chemical spill countermeasures equipment available, proposed or even just at the concept stage anywhere in the world, showed that only a small number of devices and techniques have been user-evaluated, purchased or even received much publicity or consideration by the emergency response community anywhere in the world.

The technology available for counteracting major incidents is definitely limited. For example, once a toxic or flammable gas cloud has been released, there are only a few circumstances and a limited range of devices or strategies (other than public protection measures such as indoor shelter or evacuation from the area of cloud dispersal) which, even if available and applied immediately, could reduce or eliminate the potential disastrous consequences of the release. Much further work is required to develop and assess the merits of needed new equipment, techniques and strategies.

This discussion has presented a rather pessimistic view of Bhopal-type incident countermeasures technology. The brighter side of the situation is that such incidents are rare, because of intensive efforts to prevent their occurrence. The other positive factor is that the chemical and petroleum industries have developed and put into place, a number

of basic countermeasure devices and strategies designed to handle many smaller chemical releases. These measures can be applied in many circumstances to reduce the threat that a minor or medium-sized incident might grow into a major disaster. Another positive view is that opportunities exist for new, innovative technical approaches or concepts to be explored in a comprehensive program of countermeasures research and development for spills and releases of all sizes, including major chemical accidents.

As part of its national environmental emergency program, Environment Canada has been examining this field of technology, in consultation with several advisory groups and technical committees having academic, industrial and federal participation from both Canada and the U.S. With broader consultation with provinces, territories, national associations representing industries and municipalities, a larger joint program for chemical spill technology assessment and development could be developed by governments and industry, under the guidance of Environment Canada. Such a program would be most effective and economic if governments and industries participated both technically and financially. As mentioned previously, chemical properties vary widely, although groups of different chemicals can behave similarly. This provides the opportunity for an equitable participation in a joint research program by companies in the chemical industry. Those companies producing chemicals with similar properties or behaviour could focus their contributions on countermeasures dealing with those chemicals. Industry associations could play a coordinative role in such studies, and in the wider dissemination of the resulting reports.

3.8 Post-Event Information Exchange

Emergency managers can improve contingency plans and response systems by applying lessons learned from previous accidents and near-misses, anywhere in Canada or around the world. A few systems of information exchange exist in Canada, but they primarily focus on a single industry, or only exchange information in one region of the country. Most of these exchanges are informal or verbal, because of legal concerns associated with incidents before the courts or accidents that may be the subject of future prosecution by regulatory agencies. Most of the best written information is distributed only within the confines of the corporation which experiences the problem, although it may go to all branch plants in Canada, or even to all affiliated companies around the world.

Some of the current information exchange systems in Canada include:

(a) two or three meetings per year of oil and chemical industry safety officers from the larger companies in Ontario, to discuss verbally their recent experiences and lessons. These ad hoc meetings are held as part of the "Loss Management Forum" of the Industrial Accident Prevention Association (primarily an Ontario-based association);

(b) annual safety meetings of the Canadian Petroleum Association in Alberta, where loss prevention topics in the exploration and production sector form part of the program;

(c) an annual professional development conference for members of the Canadian Society of Safety Engineering;

(d) the occasional exchange of incident information during one of the three meetings per year of the petroleum industry (PACE) Spill Response Division;

(e) the international "5-Star" audit system for industrial safety and loss prevention, presented in Ontario by the Industrial Accident Prevention Association, and also starting in Quebec;

(f) a loss control institute at the University of Waterloo which focuses on certain loss prevention matters; and

(g) others not surveyed.

At the international level, another group of independent organizations addresses loss prevention, including:

(a) the World Safety Organization based in Scotland;

(b) the American Petroleum Institute forum for standards review by member companies;

(c) the International Loss Control Institute, based in U.S.A. which originated and manages the "5-Star" audit system;

(d) the American Institute of Chemical Engineers (A.I.Ch.E), which publishes a quarterly journal "Plant/Operations Progress", hosts an annual "Loss Prevention Symposium", and has also recently announced the formation of a Centre for Chemical Process Safety for guidance on loss prevention; and

(e) the Institution of Chemical Engineers, (I.Ch.E.) in the U.K., which operates an "Information Exchange System" and publishes a bi-monthly "Loss Prevention Bulletin", devoted solely to lessons learned from industrial accidents in the U.K., Europe and around the world. The I.Ch.E. also sponsors frequent U.K. workshops and training courses on loss prevention topics.

Based on our limited review, only the latter two sources appear to provide detailed written case histories and lessons learned as the main focus of their programs, and make them available to all subscribers, independent of industry affiliation. The U.K. system has the added advantage of a full-time specialist on staff, as both editor and advisor. This system was set up in 1974 with the philosophy of a free exchange of information, and all contributors are assured anonymity (or credit) by the editor and by an independent review panel of loss prevention experts.

In summary, a more in-depth assessment of all available accident information systems in Canada and elsewhere is needed, with a view to developing a broader Canadian system or encouraging a greater Canadian participation in international systems such as those operated by A.I.Ch.E or I.Ch.E. The benefits of an annual Canadian symposium should also be examined. The key to the success of an information exchange system ultimately lies in management by an independent institution or association, to eliminate participant concerns about regulatory penalties or loss of confidentiality, as well as to ensure impartiality.

APPENDIX III -1

LOCATIONS OF REGIONAL RESPONSE CENTRES - TEAP/CCPA

APPENDIX III-1 LOCATIONS OF REGIONAL RESPONSE CENTRES - TEAP/CCPA

Company Maintaining Regional Response Centre:

ERCO, Division of Tenneco Canada Ltd.
Long Harbour, Newfoundland

C-I-L Inc.
Dalhousie, New Brunswick

Union Carbide Canada Limited
Montreal East, Quebec

Du Pont Canada Inc.
Maitland, Ontario

Cyanamid Canada Inc.
Niagara Falls, Ontario

Reichhold Limited
North Bay, Ontario

Allied Canada Inc.
Amherstburg, Ontario

Dow Chemical Canada Inc.
Sarnia, Ontario

Esso Chemical Canada
Winnipeg, Manitoba

Celanese Canada Inc.
Edmonton, Alberta

Shell Canada Chemical Company
Burnaby, British Columbia
(expected to be operational in mid-1986)

FOR ACTIVATION OF ANY OF THE ABOVE TEAP CENTRES, CONTACT THE SHIPPER OF THE PRODUCT INVOLVED, OR CANUTEC IF SHIPPER CANNOT BE REACHED

APPENDIX III-2

TEAP/CCPA - RECOMMENDED EQUIPMENT LIST

APPENDIX III-2 TEAP/CCPA - RECOMMENDED EQUIPMENT LIST

Equivalent Equipment may be Substituted

1. Scott II - 3 units
2. Walkie Talkie - 2
3. High Intensity Lights
4. Generator (for light power)
5. Nylon Slings
6. Ladder
7. Portable Eyewash
8. Grounding Cables
9. Drum Grabs
10. Hand Pump
11. Assorted Plugs

    1. 1 - small plastic bucket
    2. assorted tapered wooden plugs
    3. 1 - tapered rubber plug
    4. 1 - 1 1/2" plumbers plug
    5. 1 - 2" plumbers plug
    6. 1 - 3" plumbers plug
    7. 1 - 4" plumbers plug
    8. 1 - 5" plumbers plug
    9. 1 - 6" plumbers plug
    10. 2 - 3/4" emergency pipe and bore test plugs
    11. 2 - 1" emergency pipe and bore test plugs
    12. 2 - 1 1/4" emergency pipe and bore test plugs
    13. 2 - 1/2" emergency pipe and bore test plugs
    14. 2 - 2" emergency pipe and bore test plugs
    15. 2 - 3/4" female emergency pipe and bore test plugs
    16. 2 - 1" female emergency pipe and bore test plugs
    17. 2 - 1 1/4" female emergency pipe and bore test plugs
    18. 2 - 1 1/2" female emergency pipe and bore test plugs
    19. 2 - 2" female emergency pipe and bore test plugs
    20. 1 - 4" pump and test plug
    21. 1 - 2" plumbers plug (capped)
    22. 1 - 4" plumbers plug (capped)
    23. 1 - 8" plumbers plug (capped)

TEAP/CCPA - RECOMMENDED EQUIPMENT LIST (Cont'd)

24. 2 - 3/8" ball valves (stainless steel)
25. 2 - 1/2" ball valves
26. 1 - bicycle pump

12. Tools

1. 1 - claw hammer
2. 2 - joint breakers
3. 1 - cold chisel
4. 1 - hacksaw frame
5. 1 - tool holder
6. 1 - pair pliers
7. 1 - crescent wrench
8. 2 - spid wrenches 5/8"
9. 4 - pipe wrenches 10", 14", 18" and 24"
10. 2 - screwdrivers 6" and 8"
11. 1 - torpedo level 9"
12. 1 - pair vise grips
13. 1 - drive ratchet (8 sockets - 1/2")
14. 1 - dead blow hammer (rubber) rH-D
15. 1 - 3/4" drive breaker bar
16. 2 - 3/4" drive ext. 8"
17. 1 - 3/4" drive socket 1-13/16"
18. 1 - pair channel lock pliers
19. 1 - comb. square 12"
20. 1 - tubing cutter
21. 1 - plumb bob 8 oz.
22. 2 - drive ext. 2" x 1/2" - 5" x 1/2"
23. 1 - set drift pins 1/2", 5/8", 3/4"
24. 1 - set packing hooks
25. 1 - set Allen set screw wrenches
26. 1 - rule 6' Lufkin
27. 1 - hammer 2 lbs.
28. 1 - wire nipper 8"
29. 1 - 7/8" combination wrench
30. 1 - 1-1/16" combination wrench
31. 1 - 1 1/2" combination wrench
32. 1 - center punch
33. 2 - "C" clamps No. 406
34. 2 - grinding stones
35. 1 - tip cleaner
36. 1 - chipping hammer
37. 1 - flashlight (3-cell)
38. 1 - Phillips head screwdriver
39. 1 - wire brush
40. 1 - copus blower and accessories
41. 1 - drum mover hand truck
42. 1 - cheater bar
43. 1 - 36" pipe wrench

TEAP/CCPA - RECOMMENDED EQUIPMENT LIST (Cont'd)

44. 1 - 3/8" drill
45. 1 - drip light
46. 3 - 30' extension cords
47. 2 - 24" cable chokers
48. 2 - 48" cable chokers
49. 2 - come-a-longs

13. Clothing (Work Clothes and Personal Hygiene Items)

14. Field Glasses

15. Camera

16. Chemical Suits

4 acid suits
3 hoods
3 pairs rubber boots
2 hot suits

17. 6 Overpack Drums - Size to contain standard 55 U.S. gallon drum.

18. Drum Patching

1. 1 - scissors
2. 1 - paint scraper
3. 1 - pliers
4. 1 - channel lock
5. 1 - tin snips
6. 1 - wire brush
7. 2 - pocket knives
8. 2 - putty knives
9. 2 - screwdrivers (1 - 6" and 1 - 10")
10. 2 - 8" crescent wrenches
11. 1 - electric heat gun
12. 2 - 24 oz. ball pein hammers
13. 1 - hacksaw - 2 spare blades
14. 1 - vulcanizing plug kit
15. assorted wooden plugs
16. assorted wooden wedges
17. 4 - plastic steel kits
18. 2 - fast hardeners
19. 1 - roll duct tape
20. 6 - drum clamps
21. 1 - pk. fine sandpaper
22. 1 - pk. medium sandpaper
23. assorted square patches - rubber and sheetmetal
24. assorted sheetmetal screws - rubber washers
25. 2 - 2" x 36 yds. aluminum tape

TEAP/CCPA - RECOMMENDED EQUIPMENT LIST (Cont'd)

26. 4 - 2" x 36 yds. lead tape
27. 1 - small drum plug wrench
28. 2 - 4 lb. dead blow hammers
29. 2 - 2" x 50' rubber base magnetic tape
30. 1 - 5 lb. bag lead wood
31. 1 - package steel wool
32. 2 - flashlights
33. 1 - Phillips head screwdriver
34. 4 - toggle bolts with rubber patch
35. 2 - pks. Seagoing epoxy - 3-3/4 oz. ea.
36. 2 - pks. Devcon ST-50 epoxy - 5 1/4 oz. ea.
37. 1 - epoxy tabs - 4 oz.
38. 1 - 1" bung hole adapter with quick connector
39. 1/16" x 8" wires (for quick connectors)
40. 1 - dust brush
41. 8 - Devcon - 5-minute epoxy 1 oz.
42. 20 ea. 4" x 4" stick on labels - flammable gas, poison and corrosive

19. Safety Equipment

1. 2 - red hazard lights
2. 4 - stop signs
3. 1 - box warning triangles
4. 2 - safety blankets
5. 1 - first aid kit
6. 2 - track signs

20. Testing Equipment

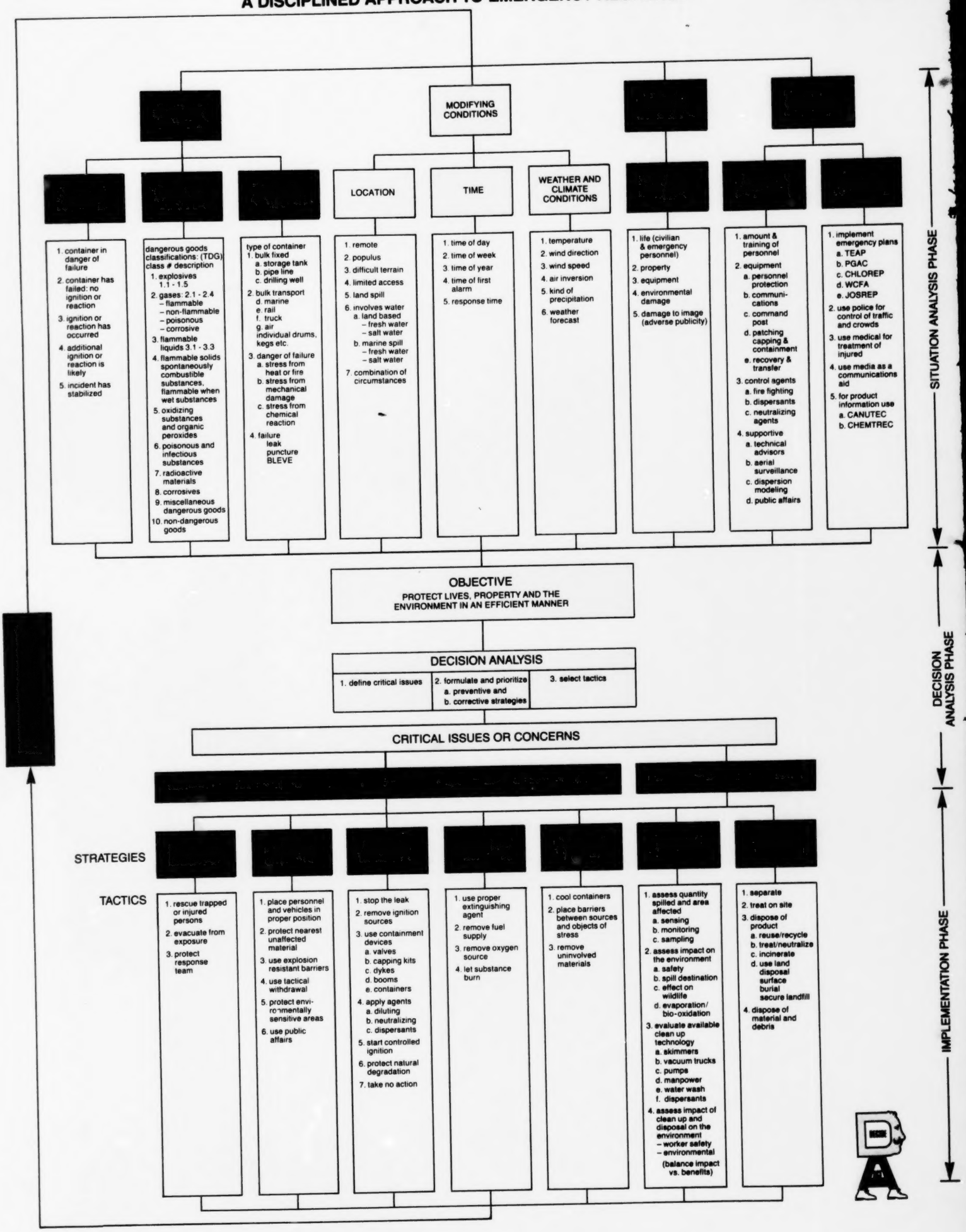
1. 1 - explosive meter
2. 1 - oxygen tester
3. 1 - dragger tube

APPENDIX III-3

The following sheet summarizes the "Disciplined Approach to Emergency Response" developed by Esso Chemicals Canada for the Canadian Chemical Producers' Association, with assistance from Lambton College, and credits for earlier related work by the National Fire Protection Association.

THE CANADIAN CHEMICAL PRODUCERS' ASSOCIATION

A DISCIPLINED APPROACH TO EMERGENCY RESPONSE


MODIFYING CONDITIONS
LOCATION
TIME
WEATHER AND CLIMATE CONDITIONS
1. container in danger of failure
2. container has failed: no ignition or reaction
3. ignition or reaction has occurred
4. additional ignition or reaction is likely
5. incident has stabilized
dangerous goods classifications: (TDG) class # description
1. explosives 1.1 - 1.5
2. gases: 2.1 - 2.4 – flammable – non-flammable – poisonous – corrosive
3. flammable liquids 3.1 - 3.3
4. flammable solids spontaneously combustible substances, flammable when wet substances
5. oxidizing substances and organic peroxides
6. poisonous and infectious substances
7. radioactive materials
8. corrosives
9. miscellaneous dangerous goods
10. non-dangerous goods
type of container
1. bulk fixed a. storage tank b. pipe line c. drilling well
2. bulk transport d. marine e. rail f. truck g. air individual drums, kegs etc.
3. danger of failure a. stress from heat or fire b. stress from mechanical damage c. stress from chemical reaction
4. failure leak puncture BLEVE
1. remote
2. populus
3. difficult terrain
4. limited access
5. land spill
6. involves water a. land based – fresh water – salt water b. marine spill – fresh water – salt water
7. combination of circumstances
1. time of day
2. time of week
3. time of year
4. time of first alarm
5. response time
1. temperature
2. wind direction
3. wind speed
4. air inversion
5. kind of precipitation
6. weather forecast
1. life (civilian & emergency personnel)
2. property
3. equipment
4. environmental damage
5. damage to image (adverse publicity)
1. amount & training of personnel
2. equipment a. personnel protection b. communications c. command post d. patching capping & containment e. recovery & transfer
3. control agents a. fire fighting b. dispersants c. neutralizing agents
4. supportive a. technical advisors b. aerial surveillance c. dispersion modeling d. public affairs
1. implement emergency plans a. TEAP b. PGAC c. CHLOREP d. WCFA e. JOSREP
2. use police for control of traffic and crowds
3. use medical for treatment of injured
4. use media as a communications aid
5. for product information use a. CANUTEC b. CHEMTREC
OBJECTIVE
PROTECT LIVES, PROPERTY AND THE ENVIRONMENT IN AN EFFICIENT MANNER
DECISION ANALYSIS
1. define critical issues
2. formulate and prioritize a. preventive and b. corrective strategies
3. select tactics
CRITICAL ISSUES OR CONCERNS
STRATEGIES
TACTICS
1. rescue trapped or injured persons
2. evacuate from exposure
3. protect response team
1. place personnel and vehicles in proper position
2. protect nearest unaffected material
3. use explosion resistant barriers
4. use tactical withdrawal
5. protect environmentally sensitive areas
6. use public affairs
1. stop the leak
2. remove ignition sources
3. use containment devices a. valves b. capping kits c. dykes d. booms e. containers
4. apply agents a. diluting b. neutralizing c. dispersants
5. start controlled ignition
6. protect natural degradation
7. take no action
1. use proper extinguishing agent
2. remove fuel supply
3. remove oxygen source
4. let substance burn
1. cool containers
2. place barriers between sources and objects of stress
3. remove uninvolved materials
1. assess quantity spilled and area affected a. sensing b. monitoring c. sampling
2. assess impact on the environment a. safety b. spill destination c. effect on wildlife d. evaporation/ bio-oxidation
3. evaluate available clean up technology a. skimmers b. vacuum trucks c. pumps d. manpower e. water wash f. dispersants
4. assess impact of clean up and disposal on the environment – worker safety – environmental (balance impact vs. benefits)
1. separate
2. treat on site
3. dispose of product a. reuse/recycle b. treat/neutralize c. incinerate d. use land disposal surface burial secure landfill
4. dispose of material and debris
SITUATION ANALYSIS PHASE
DECISION ANALYSIS PHASE
IMPLEMENTATION PHASE

RG 6120

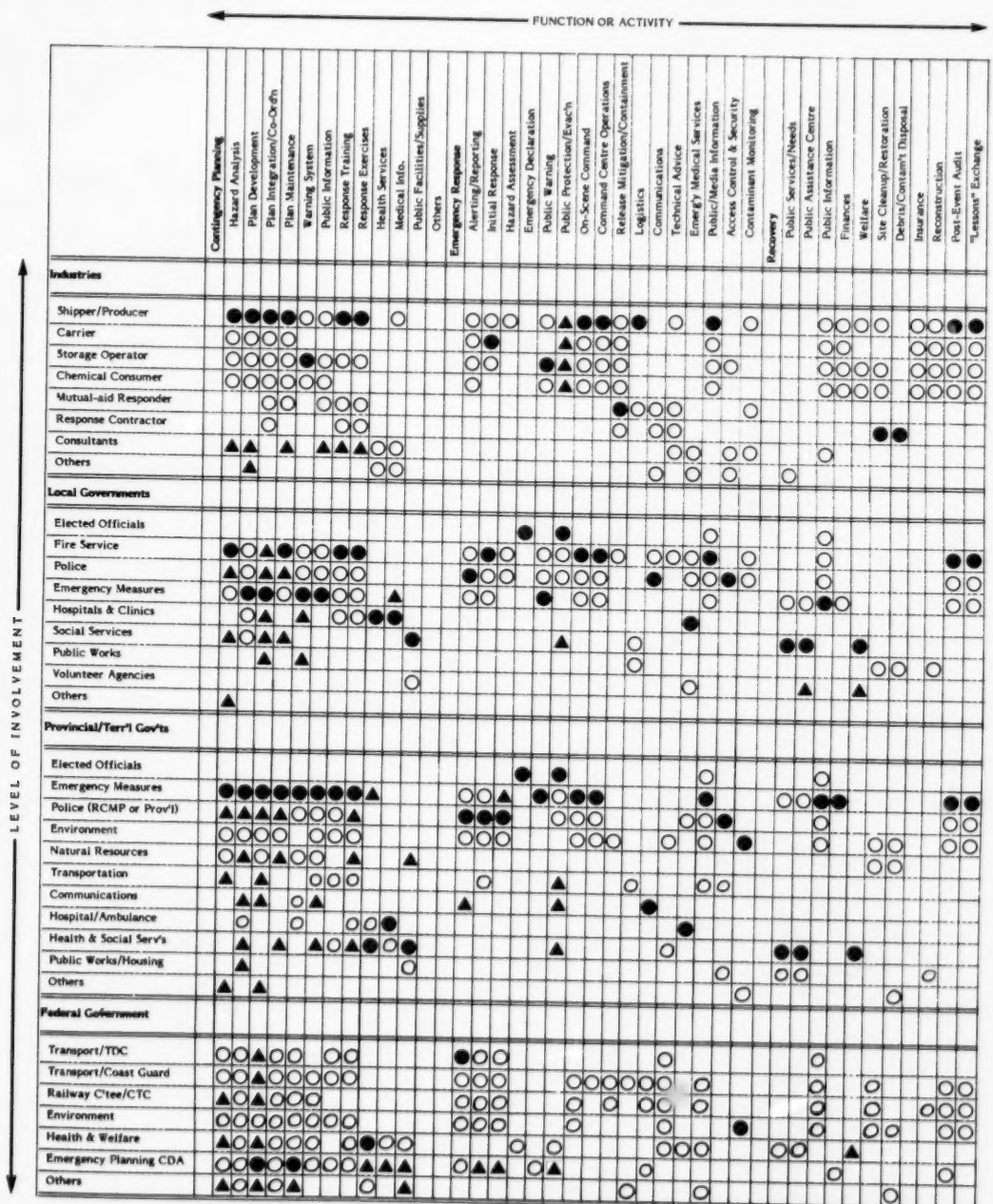
APPENDIX III-4

TYPICAL CHEMICAL EMERGENCY SYSTEMS IN CANADA

APPENDIX III-4 TYPICAL CHEMICAL EMERGENCY SYSTEMS IN CANADA

LEGEND:

- ● - denotes normal lead agency for each function & level.
- ▲ - denotes normal support agency for each function & level.
- ○ - denotes optional lead agency for each function & level, otherwise often contributing support as requested.



N.B. Readers should consult contingency plans and response agencies in their region or province/territory for specific arrangements in response to given scenarios.

APPENDIX III-5

PREPAREDNESS QUESTIONNAIRE

APPENDIX III-5 PREPAREDNESS FOR MAJOR CHEMICAL ACCIDENTS IN CANADA

A) Preparedness Survey

As part of the assessment of preparedness for chemical accidents in Canada, the working group developed a questionnaire which was sent to emergency measures organizations in all provinces and territories through the regional offices of Emergency Planning Canada. The questions were drafted to minimize subjectivity, but it was recognized that many of the questions asked for information which was not currently gathered at a provincial level. Thus, informed opinions were still necessary to respond. In many cases, the answers were generated following a discussion amongst provincial, and in some cases, federal officials involved in various aspects of emergency response in those areas.

We must stress that the survey results only provide an overview of informed opinion, and do not represent a definitive assessment. In fact, the results, along with some difficulties in distribution and interpretation of the questionnaire, have served to re-emphasize the care and sophistication needed in preparation and management of a proper survey. A recommendation has been made elsewhere in this report regarding the need for better ways of objectively assessing various capabilities for emergency response. A related comment made by one respondent questioned the merits of assessing only the response capability for chemical accidents, because this is only a small portion of the total emergency planning and response requirements for governments and industries alike.

The questions, responses and a short analysis are presented on the next 20 pages, followed by a brief summary of overall survey results.

B) **Questionnaire Response, and Analysis**

Question 1:

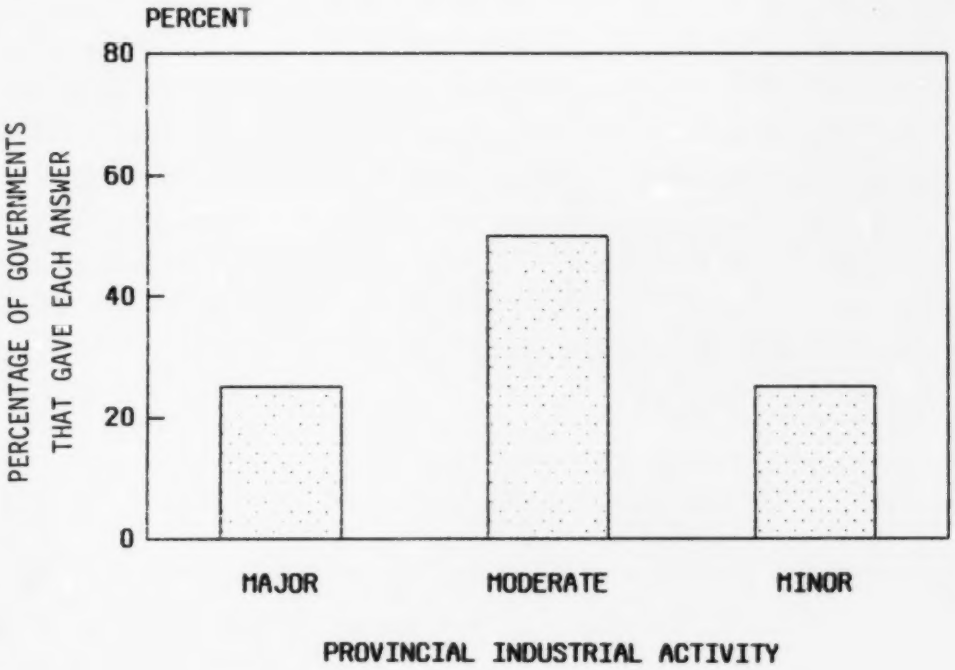
As indicated in the background comments, the relative exposure to major chemical incidents varies across the country. Would you categorize the province/territory as having:

(a) major industrial activity, including several chemical, petrochemical or petroleum refinery installations, in addition to major transportation routes near centres of population;

(b) moderate industrial activity, including a few plants as above, and/or major transportation routes near centres of population; or

(c) little industrial activity and no major transportation routes?

Response 1: (Twelve provincial/territorial governments answered this question)



Analysis 1:

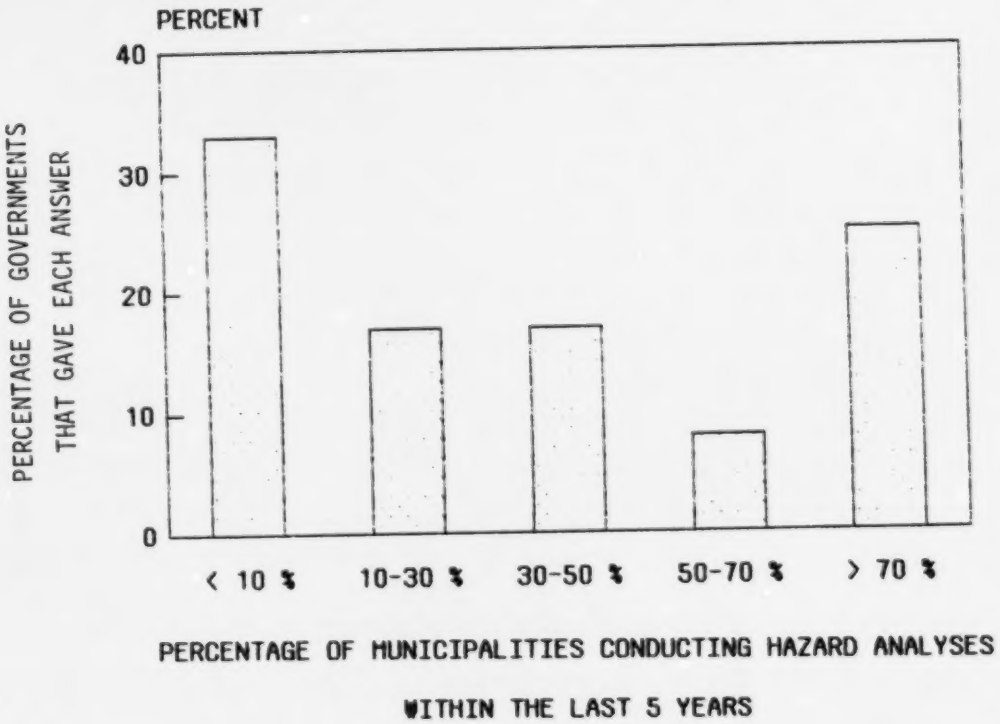
This subjective appraisal by respondents may have been influenced by their recollection of recent incidents. A more objective answer might be provided by analysis of appropriate national statistics on industries handling toxic chemicals.

Question 2:

What proportion of the municipalities/regions have in the last five years conducted a hazard analysis for potential hazardous chemical releases in their area, the results of which may have influenced their contingency plans?

(a) less than 10%
(b) 10% to 30%
(c) 30% to 50%
(d) 50% to 70%
(e) more than 70%

Response 2: (Twelve provincial/territorial governments answered this question)



Analysis 2:

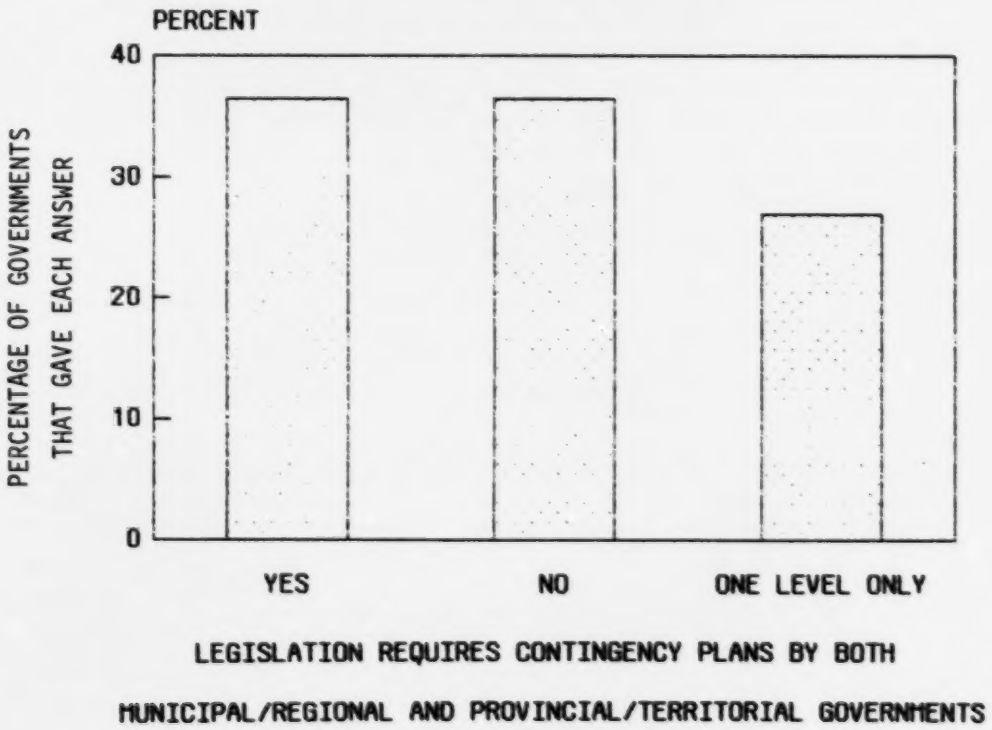
There is an apparent correlation here to the legislated requirements of provincial and territorial governments for contingency plans at the municipal/regional level. There is also a partial correlation between those governments identifying major levels of industrial activity and those showing higher proportions of hazard analysis undertaken at the municipal level.

Question 3:

There is some uncertainty that comprehensive legislation exists in all areas of the country. For your specific area(s) is there provincial/territorial legislation which requires contingency plans for governments at both the municipal/regional and provincial/territorial levels?

(a) Yes
(b) No
(c) At one level only

Response 3: (Eleven provincial/territorial governments answered this question)



Analysis 3:

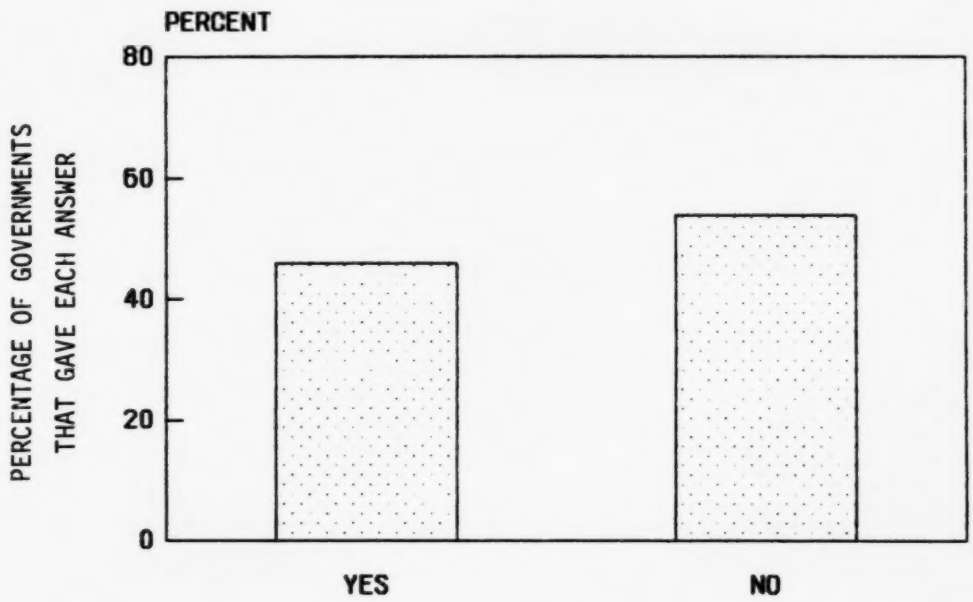
There appears to be no common approach by responding governments as to the contingency planning requirements by means of legislation.

Question 4:

Aside from the dangerous goods legislation for handlers, offerers and transporters of dangerous goods, is there any other provincial/territorial legislation which requires companies/industries dealing with hazardous chemicals (e.g., manufacturers, intermediate processors, major customers) to have contingency plans for emergency response?

(a) Yes
(b) No

Response 4: (Eleven provincial/territorial governments answered this question)



LEGISLATION REQUIRING CONTINGENCY PLANS OTHER THAN DANGEROUS GOODS LEGISLATION

Analysis 4:

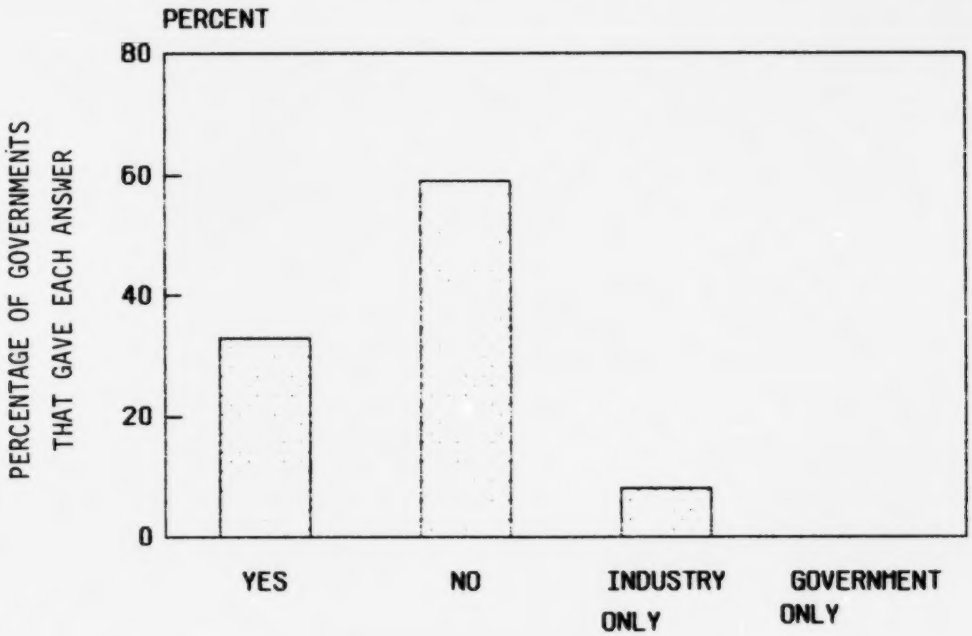
This result suggests that chemical accident hazards other than those covered by Transportation of Dangerous Goods legislation are not well-identified.

Question 5:

Is there a legislated requirement for the contingency plans in questions (3) and (4) to be exercised and updated on a periodic basis?

(a) Yes
(b) No
(c) Companies/industries only
(d) Municipalities/regions only

Response 5: (Twelve provincial/territorial governments answered this question)



Analysis 5:

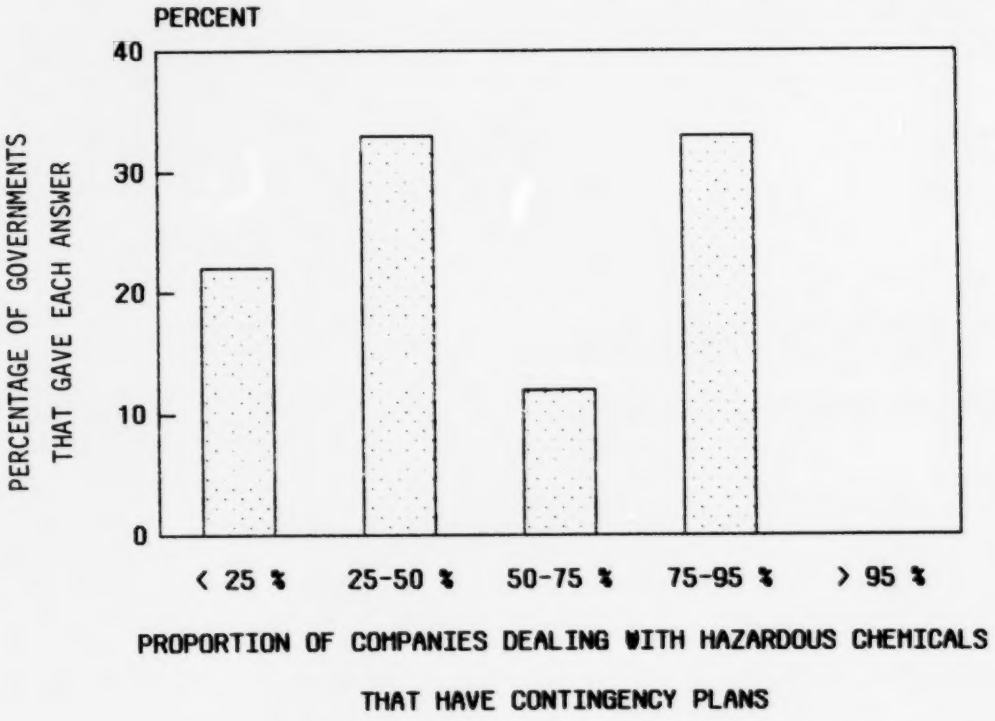
Most governments have not formalized the need for updating and exercising of contingency plans in their legislation. Many legislators may have considered that such activities occur automatically in plan development by professionals. There is a correlation between those governments which require plans at both provincial and municipal levels, and the ones which specify requirements for periodic updates and exercises.

Question 6:

Regardless of the legislative requirements above, what proportion of the companies/industries which deal with hazardous chemicals (including manufacturers, shippers, transporters, handlers and major users) now have in place spill/release contingency plans which will be or are periodically exercised and updated?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 6: (Nine provincial/territorial governments answered this question)



Analysis 6:

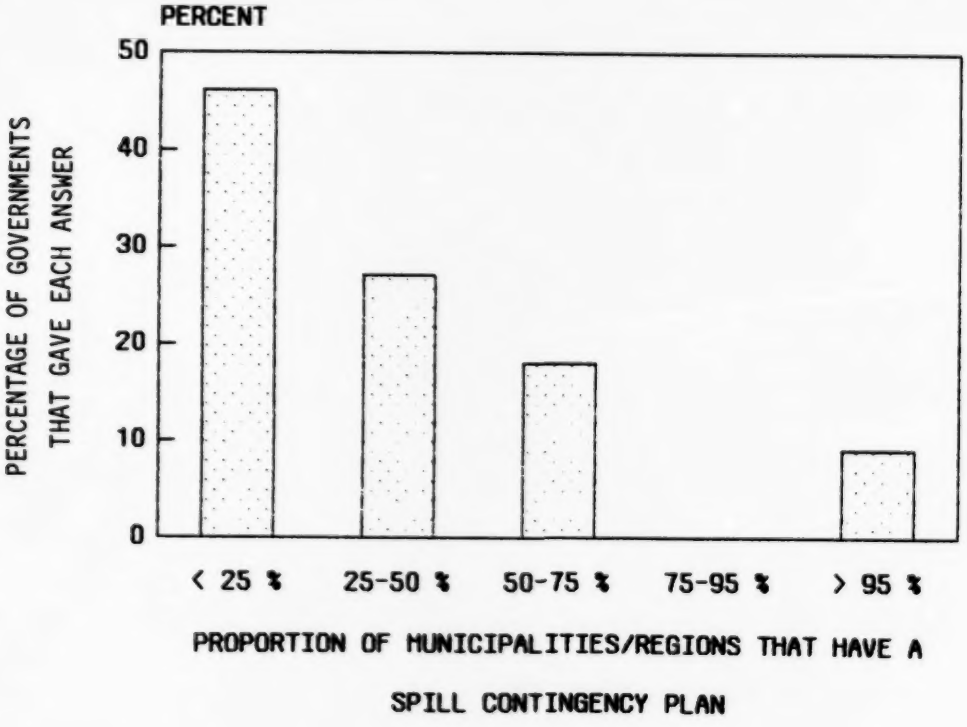
No trends or conclusions could be identified for this fairly uniform distribution of answers. There was little correlation between the identified levels of industrial activity and the proportions of spill contingency plans completed by industrial companies in each jurisdiction. A few provinces indicated that specific data on this question were not available.

Question 7:

As in question 6, what proportion of the municipalities/regions now have in place spill contingency plans which are periodically exercised and updated?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 7: (Eleven provincial/territorial governments answered this question)



Analysis 7:

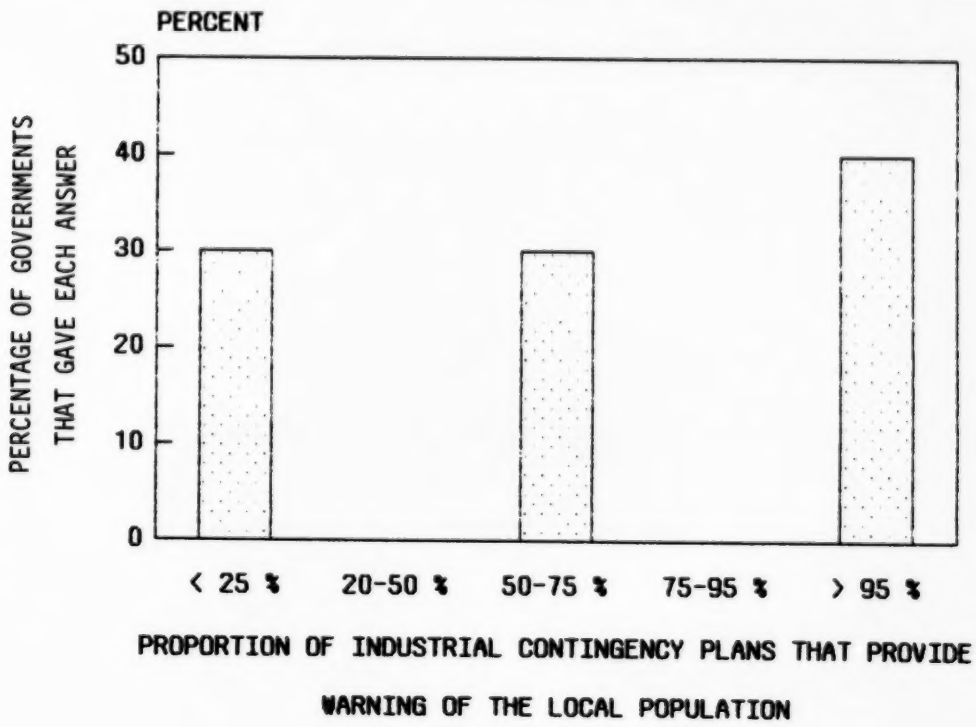
This question did not address the quality of available contingency plans, but inferred that the mere existence of plans which are updated and exercised provides evidence of preparedness. The results suggest that most municipalities are not completely prepared for major chemical spills. There may be some heightened awareness (through recent legislation and incidents) of the risks of dangerous goods transportation, but this has not apparently resulted in many actions to improve municipal plans. There was only partial correlation between the levels of industrial activity and the levels of municipal government preparedness for chemical accidents.

Question 8:

What proportion of the industrial contingency plans which have been prepared provide for direct, early warning to ensure adequate alerting and response procedures at the local level outside the plant boundaries?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 8: (Ten provincial/territorial governments answered this question)



Analysis 8:

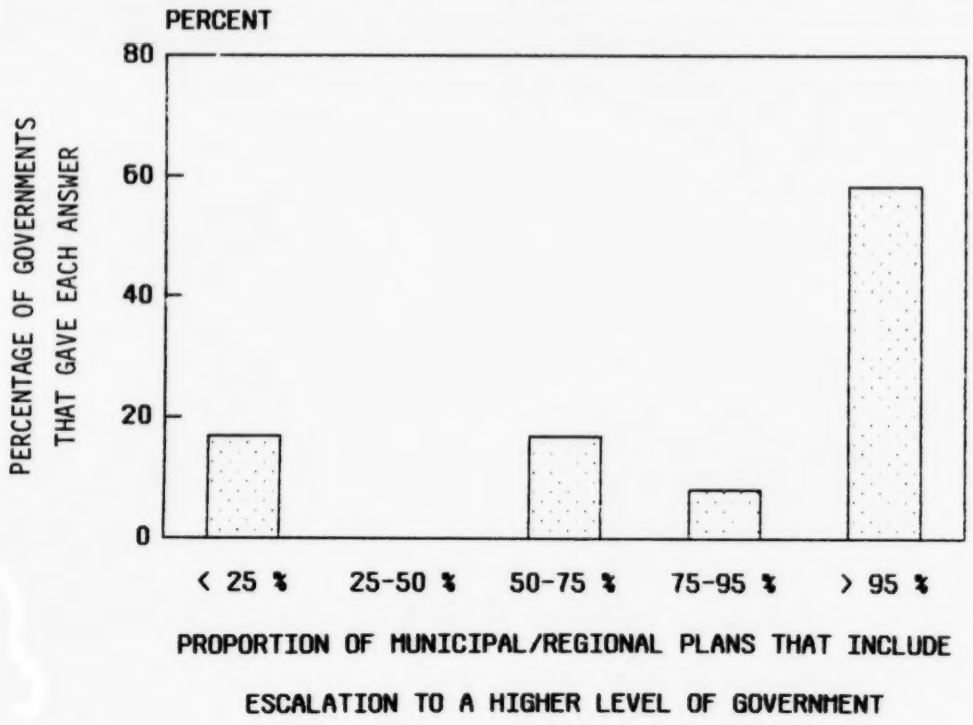
It is difficult to identify a conclusion or trend in these responses. The question might have been improved if it had been linked to the smaller sub-set of plants which have a potential for off-site releases of toxic chemicals. There is, however, a reasonable correlation between those responses which indicated major levels of industrial activity, and those which indicated that plans, where they have been prepared, provide for local warnings.

Question 9:

What proportion of the municipal/regional plans include an escalation process to a higher level of government?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 9: (Twelve provincial/territorial governments answered this question)



Analysis 9:

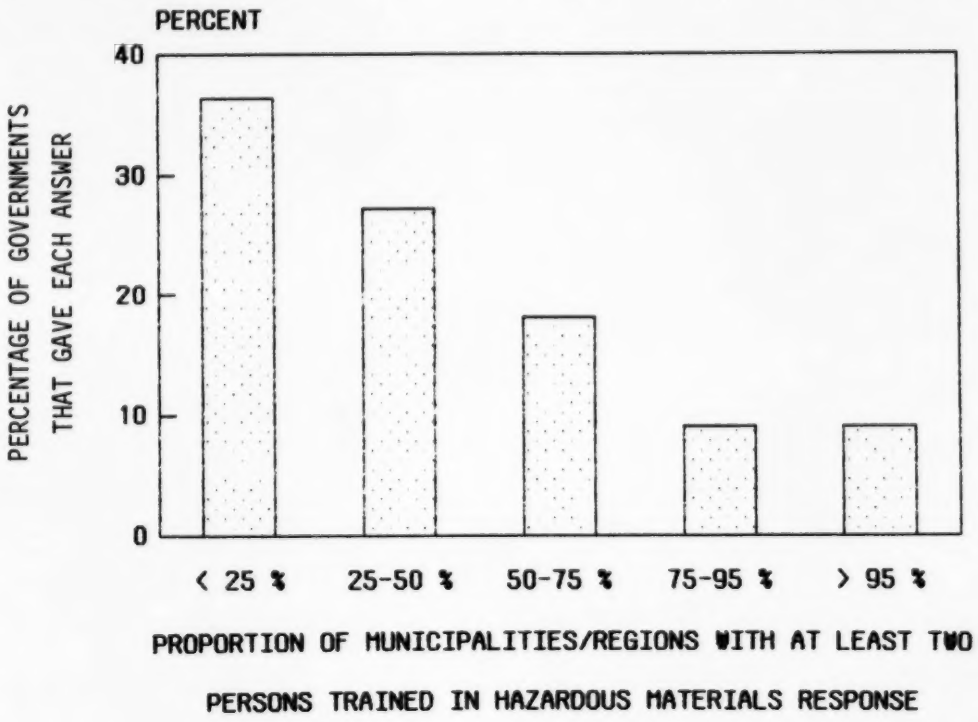
The trend of responses suggests that the escalation mechanisms are largely in place for municipal/regional contingency plans.

Question 10:

At the municipal/regional level, what proportion of municipalities have had at least two people trained in basic hazardous materials response countermeasures?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 10: (Eleven provincial/territorial governments answered this question)



Analysis 10:

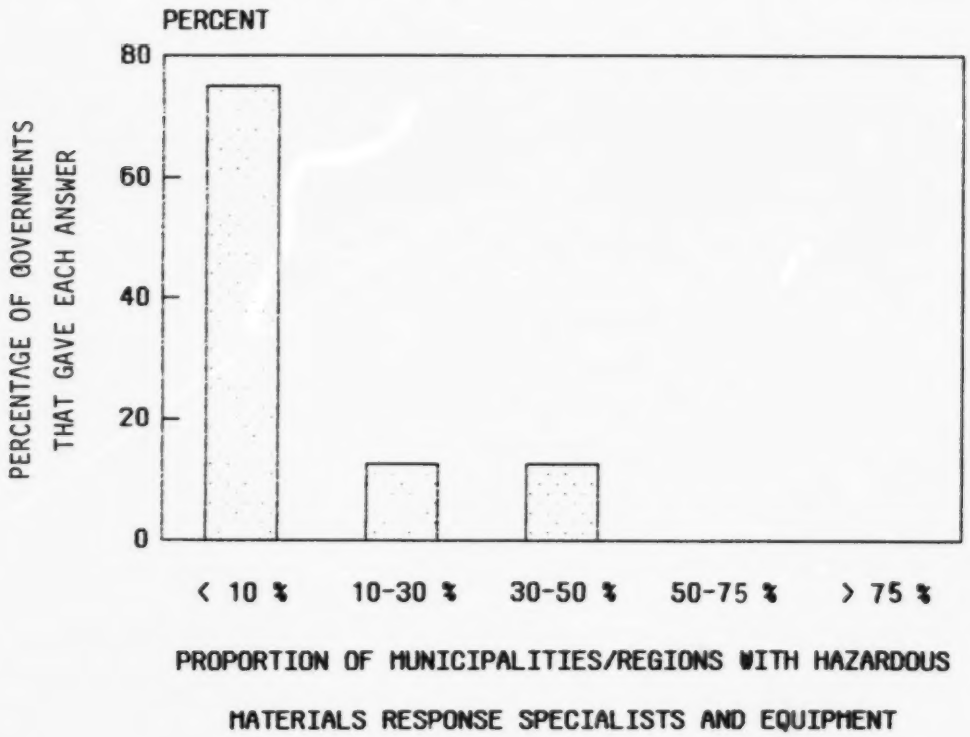
The results suggest that, in general, relatively few people are trained at the municipal/regional level, in basic response countermeasures. A more detailed survey would likely determine that larger, more industrialized municipalities do have some trained personnel, mostly in the fire service.

Question 11:

What proportion of municipalities located in high or medium threat areas have designated haz-mat specialists and have been equipped with hazardous materials response equipment (other than normal turnout gear and SCBA's), such as totally-encapsulated chemical suits, and specialized tools, equipment and instrumentation?

(a) less than 10%
(b) 10% to 30%
(c) 30% to 50%
(d) 50% to 75%
(e) more than 75%

Response 11: (Nine provincial/territorial governments answered this question)



Analysis 11:

The results here are similar to those for the previous question; the trend is even more pronounced because of financial/personnel limitations. A more detailed survey would probably show that only a few larger, more industrialized Canadian cities have specially-equipped teams in their fire service for response to hazardous materials incidents.

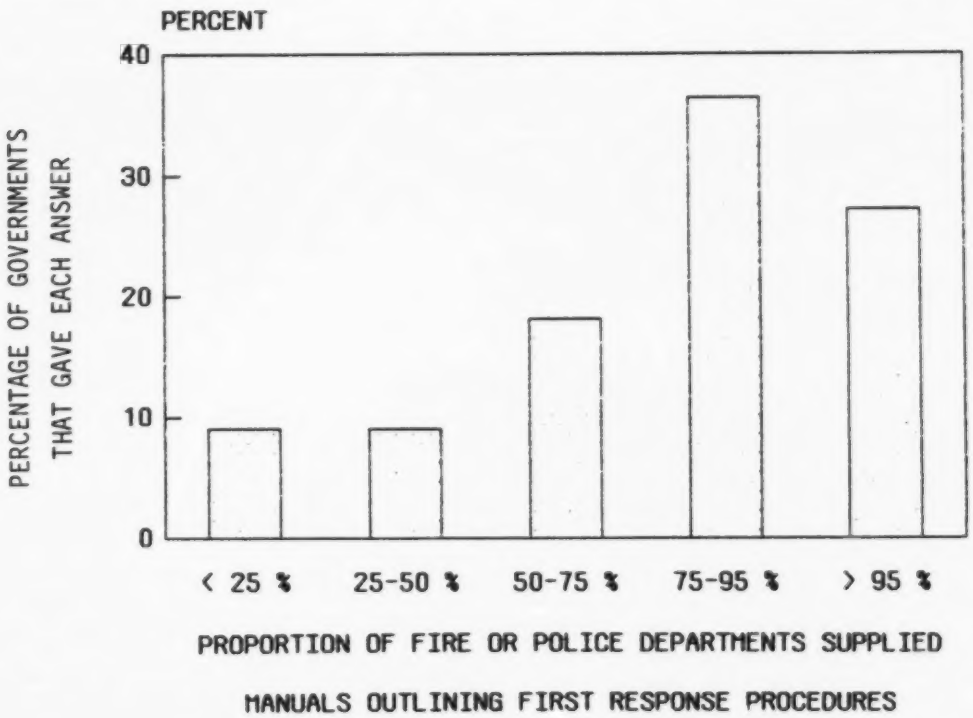
Question 12(i):

At the municipal/regional level, what proportion of the fire or police departments are:

(i) supplied with manuals outlining appropriate first response procedures for major chemical incidents?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(i): (Eleven provincial/territorial governments answered this question)



Analysis 12(i):

Most fire or police departments have access to first responder manuals.

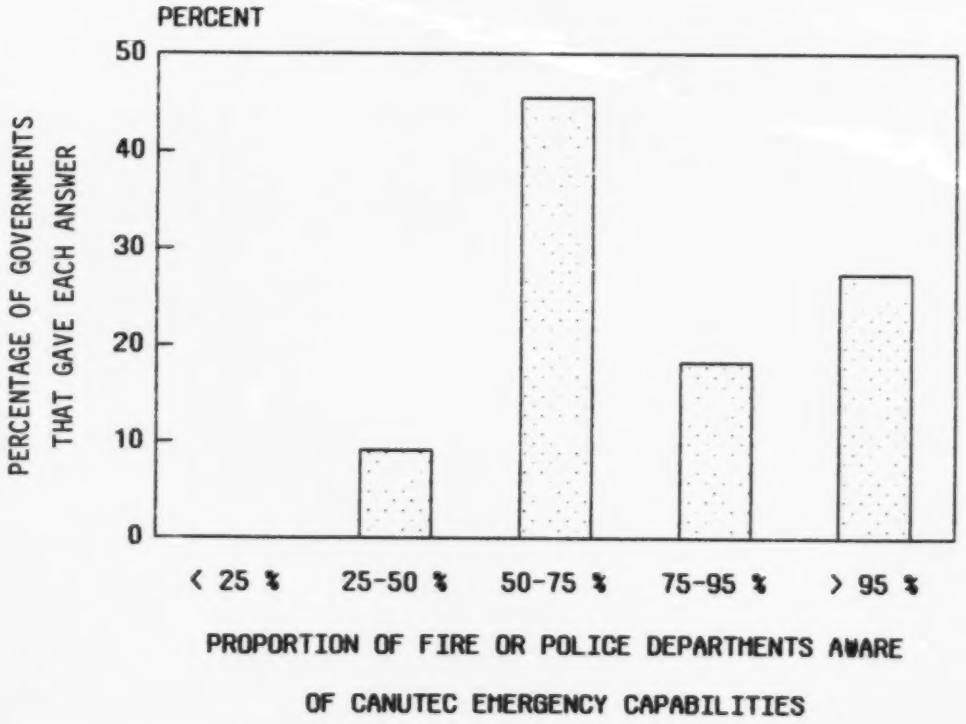
Question 12(ii):

At the municipal/regional level, what proportion of the fire or police departments are:

(ii) aware of the CANUTEC emergency centre's capabilities and telephone numbers?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(ii): (Eleven provincial/territorial governments answered this question)



Analysis 12(ii):

Most fire and police departments appear to be aware of CANUTEC and its capabilities.

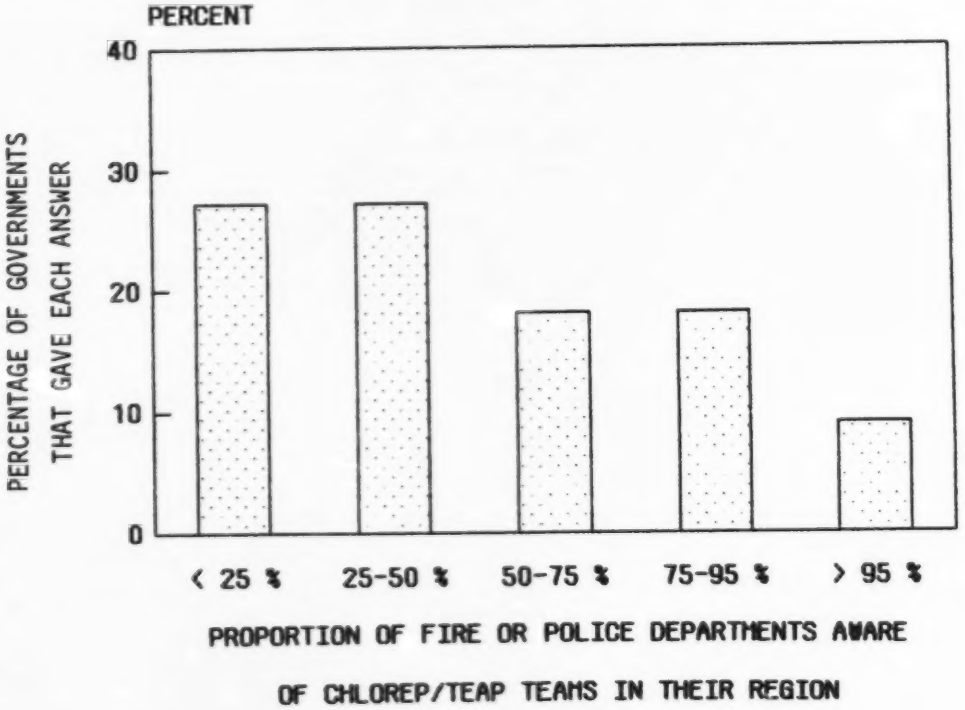
Question 12(iii):

At the municipal/regional level, what proportion of the fire or police departments are:

(iii) aware of industry emergency telephone numbers for response by TEAP/CHLOREP etc., teams in their province/region?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(iii): (Eleven provincial/territorial governments answered this question)



Analysis 12(iii):

Compared to the trends indicated in parts 12(i) and 12(ii), the degree of awareness by fire and police departments of regional spill response arrangements appears to fall off as the level of response shifts from "first on-scene" to the more advanced response by industrial specialists.

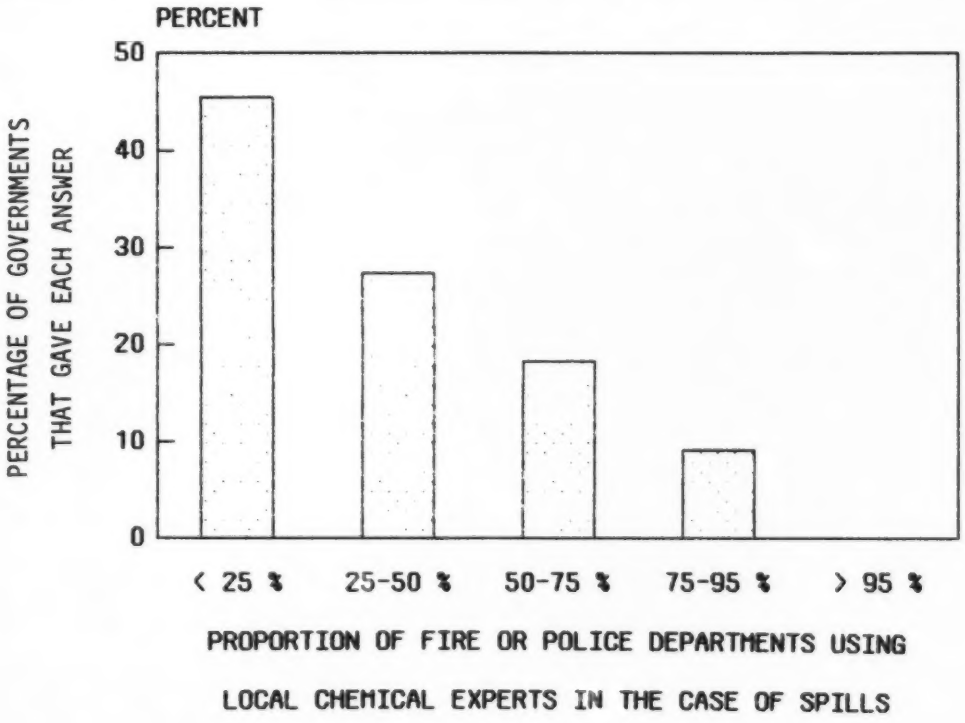
Question 12(iv):

At the municipal/regional level, what proportion of the fire or police departments are:

(iv) aware of and have made arrangements for local/regional chemical experts to advise them during chemical incidents?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(iv): (Eleven provincial/territorial governments answered this question)



Analysis 12(iv):

The fall-off in first-responder awareness with increasing level of response sophistication appears to continue here.

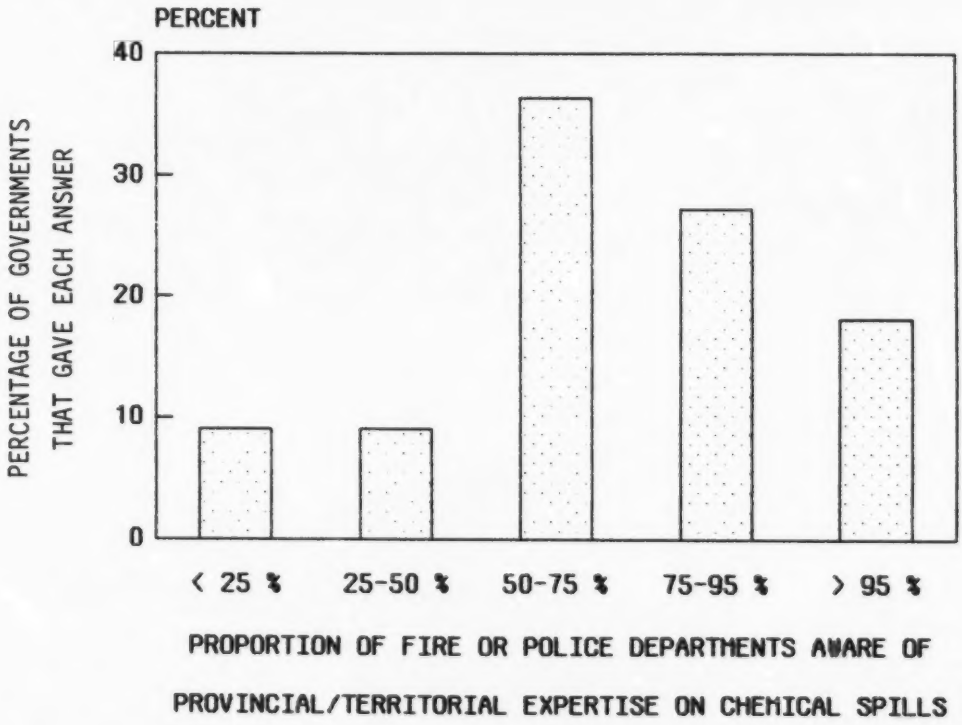
Question 12(v):

At the municipal/regional level, what proportion of the fire or police departments are:

(v) aware of other technical guidance and information sources on chemical emergencies available within their provincial/territorial governments (provincial EMO's, ministries of environment, etc.)?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(v): (Eleven provincial/territorial governments answered this question)



Analysis 12(v):

Most fire and police departments are apparently aware of provincial sources of information and advice on chemical spills.

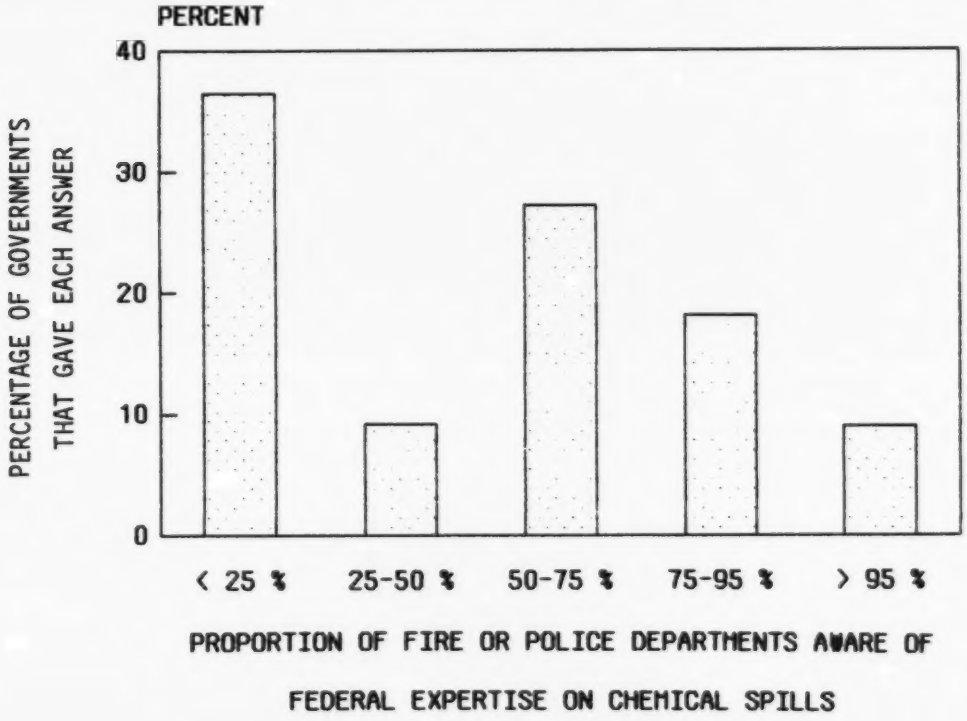
Question 12(vi):

At the municipal/regional level, what proportion of the fire or police departments are:

(vi) aware of other supplementary technical guidance and information sources on chemical emergencies, available from the federal government (federal EPC, DOT, DOE, etc.) through their appropriate contacts?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 12(vi): (Eleven provincial/territorial governments answered this question)



Analysis 12(vi):

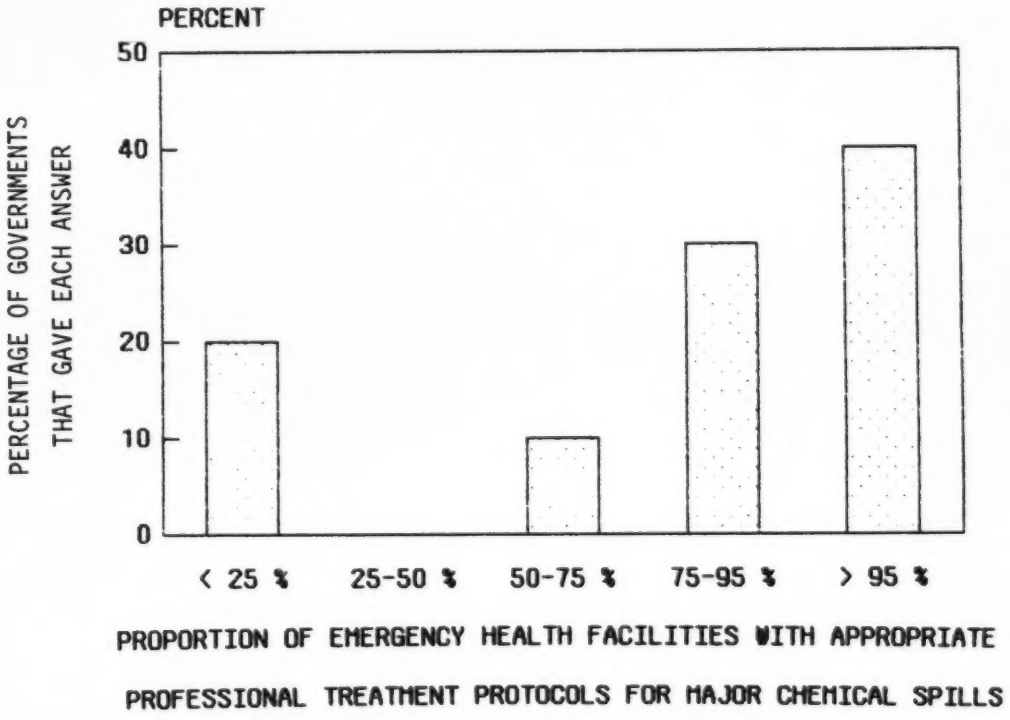
In some provinces, there seems to be little awareness of federal information sources for chemical spills at the municipal/regional level. There appears to be a correlation for a higher level of this local knowledge in those provinces that have traditionally participated in greater numbers of joint federal-provincial programs.

Question 13:

What proportion of emergency health facilities (poison control centers, hospitals, emergency clinics, etc.) have a method of accessing the appropriate professional treatment protocols (i.e., clinical) to deal with a major chemical incident in their region?

(a) less than 25%
(b) 25% to 50%
(c) 50% to 75%
(d) 75% to 95%
(e) more than 95%

Response 13: (Ten provincial/territorial governments answered this question)



Analysis 13:

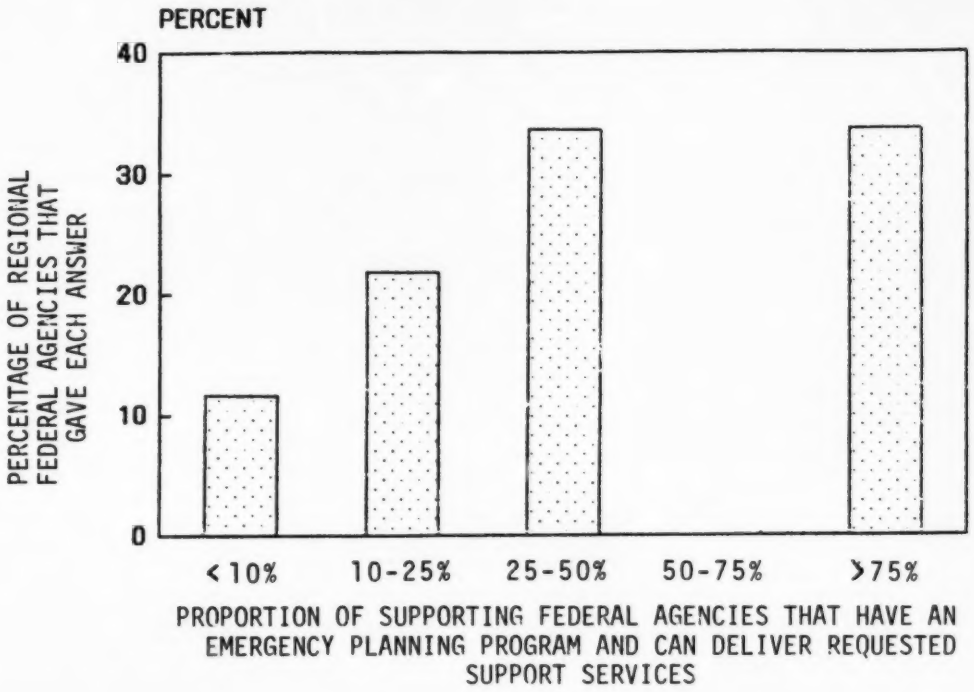
A majority of respondents believe that most emergency health facilities have access to adequate information for dealing with a major chemical incident. According to comments received during the report review period, these views might be modified substantially if specific questions about the broader questions of mass casualty care were to be raised.

Question 14:

What proportion of federal agencies which might be required to provide support services in a major chemical incident have a program in place to meet the requirements of the federal Emergency Planning Order, and can deliver this support at the regional and lower levels?

(a) less than 10%
(b) 10% to 25%
(c) 25% to 50%
(d) 50% to 75%
(e) greater than 75%

Response 14: (Regional representatives of federal government agencies answered this question for nine of the twelve provincial/territorial areas where they are responsibilities)



Analysis 14:

A range of views about federal agency readiness is apparent. One respondent gave a regional summary which seems applicable for the country as a whole - that there are approximately 15 federal agencies that have either a legislated responsibility or a capability for supporting other agencies/governments in the event of a toxic chemical release. Of these 15 agencies, about one-third have few arrangements in place and depend on Emergency Planning Canada to carry them through, one-third have sufficient arrangements in place, and the remaining third's capabilities vary from indeterminate to moderate.

C) Survey Results Summary

A survey of this type, with its associated assumptions and limitations, is only of some value in identifying response capabilities and shortcomings. Factors not included in the survey questions are often of primary importance in determining areas for further action or attention. These factors include financial and human resource restraints, as well as the degree of consistent political will for emergency preparedness improvements.

The survey has nevertheless been helpful in confirming opinions or renewing resolutions that more effort could and should be made to prepare for those potentially major chemical accidents which cannot be prevented. The survey shows that many industries and all levels of government must examine their respective areas of responsibility, and work together to improve the nation's collective capability to deal with a chemical release, as a part of preparations for many types of emergencies, both man-made and natural.

APPENDIX III-6

EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS

APPENDIX III-6 EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS

"POTENTIAL" CATEGORY	EXAMPLE PRODUCTS (Canadian Production)	MAJOR MANUFACTURERS AND/OR SUPPLIERS	CCPA/TEAP RESPONSE PLAN YES	CCPA/TEAP RESPONSE PLAN NO	OTHER PLANS FOR MUTUAL AID*
Toxics (TDGA Classes 2.3 and 2.4)	1) Ammonia (14 plants-3.5 million tonnes in 1984)	CIL	Yes		TEAP plan nationally plus western response plan of Western Canada Fertilizer Association
		Cominco		No	
		Cyanamid	Yes		
		Can. Fertilizers		No	
	2) Arsine (?)	Not available			(?)
	3) Chlorine (13 plants-1.4 million tonnes in 1984)	CIL	Initial response may come from TEAP		CHLOREP plan also applies for chlorine
		Dow			
		FMC			
	4) Hydrogen Chloride (13 plants-135 kilotonnes in 1982)	Dow	Yes		--
		CIL	Yes		
		Du Pont	Yes		
	5) Hydrogen Fluoride (3 plants-69 kilotonnes in 1984)	Allied	Yes		Mutual-aid plan of HF producers in Canada & U.S.
	6) Sulphur Dioxide (2 plants-125 kilotonnes)	CIL	Yes		(?)
		Cominco		No	(?)
	7) Hydrogen Sulphide (4 plants and many "sour" wells and gas plants-11.9 kilotonnes in 1980 plus ? kilotonnes of sour gas in -)	Thio Pet		No	(?)
		Laurentide		No	(?)
		Many Oil and Gas Cos.		No	(?)

* Supplementary to Company Contingency Plan
(?) No information available

APPENDIX III-6 EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS (Cont'd)

"POTENTIAL" CATEGORY	EXAMPLE PRODUCTS (Canadian Production)	MAJOR MANUFACTURERS AND/OR SUPPLIERS	CCPA/TEAP RESPONSE PLAN YES	CCPA/TEAP RESPONSE PLAN NO	OTHER PLANS FOR MUTUAL AID*
Flammable Gases (TDGA Class 2.1)	1) Acetylene (?)	Can. Liquidair		No	(?)
		Union Carbide	Yes		--
		Gulf	Yes		--
	2) Butadiene (Inhib.) (4 plants-260 kilo-tonnes in 1983)	Polysar	Yes		--
		Dow (Supplier)	Yes		--
		Monsanto (Supplier)	Yes		--
	3) Butane (?)	Dome Petroleum		No	PGAC plan applies for butane
		Pacific Petroleum		No	
		Mobil Oil		No	
		Home Oil		No	
	4) Butylenes (8 plants-135 kilo-tonnes in 1983)	Polysar	Yes		--
		Finachem		No	(?)
		Esso Chemical	Yes		--
	5) Ethyl Chloride (?)	Ethyl Canada	Yes		--
		Dow (Supplier)	Yes		--
	6) Ethylene (6 plants-2.2 million tonnes in 1983)	Esso Chemical	Yes		--
		Gulf	Yes		--
		Alta Gas Chem	Yes		--
		Petrosar	Yes		--
		Dow	Yes		--
	7) Ethylene Oxide (3 plants-390 kilo-tonnes in 1984)	Union Carbide	Yes		--
		Dow	Yes		(?)
		Matheson (Supplier)		No	(?)

* Supplementary to Company Contingency Plan
(?) No information available

APPENDIX III-6 EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS (Cont'd)

"POTENTIAL" CATEGORY	EXAMPLE PRODUCTS (Canadian Production)	MAJOR MANUFACTURERS AND/OR SUPPLIERS	CCPA/TEAP RESPONSE PLAN YES	CCPA/TEAP RESPONSE PLAN NO	OTHER PLANS FOR MUTUAL AID*
Flammable Gases (Cont'd) (TDGA Class 2.1)	8) Hydrogen (More than 65 plants incl. 25 large plants-1.1 million kilotonnes in 1983)	Syncrude		No	(?)
		Can. Fertilizers		No	(?)
		Alta Gas Chems	Yes		--
		Cominco		No	(?)
	9) Hydrogen Sulphide (see "Toxics" Group 1)	--	--	--	--
	10) Methane (?)	Can. Liquid Air		No	(?)
	11) Natural Gas (3500+ wells-480 million tonnes in 1983)	Many Oil and Gas Cos.		No	(?)
	12) Propane (?)	Superior			PGAC plan applies for propane
		Consumers Co-op.			
		Dome Petroleum			
		Goliad			
		Mobile Oil			
		Pacific Petroleum			
		Home Oil			
	13) Propylene (5 plants-564 kilotonnes in 1983)	Petrosar	Yes		--
		Esso Chem	Yes		--
		Petromont	Yes		--
	14) Vinyl Chloride (2 plants-330 kilotonnes in 1983)	Dow	Yes		--

* Supplementary to Company Contingency Plan
(?) No information available

APPENDIX III-6 EXAMPLE CHEMICALS AND RELATED MUTUAL-AID RESPONSE PLANS (Cont'd)

"POTENTIAL" CATEGORY	EXAMPLE PRODUCTS (Canadian Production)	MAJOR MANUFACTURERS AND/OR SUPPLIERS	CCPA/TEAP RESPONSE PLAN YES	CCPA/TEAP RESPONSE PLAN NO	OTHER PLANS FOR MUTUAL AID*
Flammable Liquids (TDGA Class 3.1, 2.2, and 3.3)	1) Carbon Disulphide (?)	Cornwall Chem		No	(?)
		Thio Pet Chem		No	(?)
	2) Hydrazine (?)	Not available			(?)
	3) Propylene Oxide (1 plant-63 kilotonnes in 1983)	Dow	Yes		--
Explosive Substances (TDGA Classes 1.1 and 1.5)	1) Ammonium Nitrate (1 plant explosive grade-165 kilotonnes in 1984)	Dupont	Member, but TEAP not established for explosives		Investigation after explosions by Explosives Branch of EMR or by Bureau of Explosives (AAR) if on railway
Toxic Products of Reaction (from TDGA classes 4.2, 6.1 and 9.2)	1) Phosphorus (2 plants-68 kilotonnes in 1984)	Erco	Yes		--
	2) Sodium Cyanide (1 plant-2 kilotonnes in 1982, plus 7 kilotonnes imported)	Dupont (?)	Yes		--
		CIL (importer)	Yes		--

* Supplementary to Company Contingency Plan
(?) No information available